

NORTH AMERICAN SPECIES OF AMBLYSTEGIUM.

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(WITH PLATES XI-XIII)

INTRODUCTION.

AMERICAN students of bryology have felt for several years that the characterization of the several species of *Amblystegium* expressed in the descriptions of them now available, are unsatisfactory in many respects. While I was engaged in naming some collections of mosses I met this difficulty and was led to make a closer study of the group, in order, if possible, to discover some clearer diagnostic characters for the several species.

To do such work in the most satisfactory manner the worker should have before him the plants from which the original descriptions were made. Had it been possible for me to prolong this work indefinitely I should have endeavored to see all existing types, notwithstanding the fact that they are widely scattered, and some of them probably available only after months of search. But I have been compelled by circumstances over which I did not have complete control to bring my work to a close without seeing several of the types. In the absence of these, I selected material named by bryologists of recognized ability, compared it carefully with material of other authorities, with the original descriptions and figures, and later ones of good standing, and selected for my descriptions and illustrations those forms which agreed best with the consensus of opinion as expressed in existing descriptions and figures.

In addition to the characters commonly enumerated in descriptions, such as color, general habit, disposition of archegonia and antheridia, I have added some structural characters of both gametophyte and sporophyte, and the averages of a large number of measurements of cells and organs in both.

Such expressions as "a little longer than in the preceding," "shorter than in the former species," etc., are of very little value in the description of any plant, since one man's mole hill may be another's mountain. For the gametophyte I have given the following measurements: length and diameter of stem; length of branches; diameter of central strand when present; diameter of cells in cortex; central strand and ground tissue; dimensions of leaf and leaf cells in three regions, alar, middle, and apical. For the sporophyte measurements were made of the length; the diameter of the seta, its central strand, and the cells of its three tissue regions; the length of the capsule; the dimensions of the exothecium cells and the stomata found on the collum. The averages for the leaf cells were obtained by measuring cells in each of the three regions from five leaves, taking five cells from each region of each leaf. To obtain the average dimensions of leaves a larger number were measured, and for averages of the exothecial cells and those of stomata from ten to twenty or more were measured, whenever there were so many.

In general I have found that the characters of the sporophyte have comparatively little diagnostic value. There are occasional exceptions. For instance, on the collum of the capsule of *A. noterophilum* there are from ninety to two hundred stomata. These are commonly more or less clustered, as many as seven contiguous ones in a single instance being found. In the nearly related species, *A. fluviatile*, the number reaches eighty, while in another related species, *A. irriguum*, the number is usually below forty-five; and in both these species they are scattered.

We must still look to the leaves for the principal characters by which to separate the species. Their shape and size, the size of the cells in the different regions, the presence or absence of a costa and its relative length and diameter are the most available marks. For this reason I have drawn illustrations only of leaves and parts of leaves, with a single exception of *A. noterophilum*. In this case there are no other figures of the capsule known to me.

The student who undertakes the study of *Amblystegium* must do so with the understanding that he is dealing with a group of exceedingly variable species with many intermediate forms, and must treat them accordingly or meet with disappointment in the end. After long study I am fully convinced that the genus will always prove a troublesome one to the systematist.

HISTORICAL.

The genus *Amblystegium* was established by Bruch, Schimper, and Gumbel in their *Bryologia Europæa* in 1853, with sixteen species, including *Campylium polygamum* and *Hypnum kneiffii*. Of these, *A. serpens* and *A. riparium* were known to Linnaeus and Dillenius as *Hypnum*. *A. fluviatile* was described by Swartz in 1799 as *Hypnum fluviatile*, and figured under the same name two years later by Hedwig. Haller described *A. subtile* under the name *H. minimum* in 1768. Hedwig (1801) referred it to *Leskea* as *L. subtilis*. In this he was followed by Bridel in 1827. *A. confervoides* was described by Bridel in 1812 as *H. confervoides*, and figured by Schwægrichen in 1826 under the name *H. conferva*. *A. radicale* was first described and figured by Hedwig in 1801 as *Leskea varia*, and referred to *Amblystegium* by Bruch, Schimper and Gumbel, who adopted the specific name applied in 1805 by Palisot de Beauvois to a moss somewhat similar in appearance and supposed to be identical but belonging elsewhere. *A. subnerve*, *A. kochii*, *A. enerve*, *A. oligorrhizon*, *A. curvipes*, and *A. tenuissimum* were established by the authors of the *Bryologia Europæa*. In 1845 Spruce sent a moss to Bruch who in a letter named it *Leskea sprucei*. This is *A. sprucei* of Bry. Eur. *A. irriguum* was described and figured by Wilson in 1855 as *Hypnum irriguum*.

Wilson in the third edition of *Bryologia Britannica* (1855) did not recognize the genus *Amblystegium*, choosing to refer the species so named by the authors of Bry. Eur. to *Hypnum* and *Leskea*. Schimper however maintains *Amblystegium* in both editions of his *Synopsis Muscorum Europæorum*, excluding in the first (1860) *A. polygamum*, *A. kneiffii*, and *A. subnerve*,

and adding *A. saxatile* and *A. juratzkanum*. In the second edition (1876) three new species are added, *A. porphyrrhizum* Lindb., *A. leptophyllum* Sch., and *A. hausmani* De Not.; while *A. saxatile* becomes *A. hygrophilum*. In both editions of this work the genus is divided into two subgenera, *Amblystegium* and *Leptodictyum*. De Notaris in *Epilogo della Briologia Italiana* (1869) recognizes the genus *Amblystegium*, but makes it include many *Hypna* of the Bry. Eur. Milde in *Bryologia Silesiaca* (1869) adopts in all essential features Schimper's conception of the genus, but adds *Hypnum filicinum* Auct. and *H. fallax* Brid. Du Buysson in *Essai analytique du genre Amblystegium* (1883) follows Schimper for generic limits, but reduces several species to varieties. Renauld and Cardot in *Musci Americæ Septentrionalis* (1893) adopt Schimper's limits for the genus. Husnot in *Muscologia Gallica* (1894) does so with Milde's modifications. Dixon and Jameson in *The Student's Handbook of British Mosses* (1896) follow Husnot in large part, but exclude *A. riparium*, which they refer to *Campylium*. Braithwaite in *British Moss Flora* adopts the limits assigned the genus by De Notaris.

Sullivant in *The Mosses and Hepatics of the United States* (1856) recognizes *Amblystegium* as a subgenus under *Hypnum*, adopting in general Schimper's limits, but including *Hypnum polygamum*. In *Icones Muscorum* (1864) *Amblystegium* is still considered a subgenus of *Hypnum*. In Lesquereux and James' *Mosses of North America* the arrangement of Sullivant is followed, with the exception of *H. polygamum*, which is placed under the subgenus *Campylium*. Austin in *Musci Appalachiani* (1870) follows Schimper, but reduces many species of the latter and other authors to the rank of varieties. Macoun and Kindberg in *Catalogue of Canadian Plants* likewise follow Schimper.

GENERIC LIMITS.

To me the generic limits established by Schimper appear to be the most natural ones. As thus defined, the genus includes at least two species, *A. riparium* and *A. vacillans*, whose leaf

structure, considered alone, might place them elsewhere; but when account is taken of the sum of their characters, they must be referred to *Amblystegium*. I cannot agree, therefore, with Messrs. Dixon and Jameson, who, in their recent admirable *Handbook*, have placed the former in the genus *Campylium*. Nor can I accept the inclusion of *Hypnum filicinum* and its near relatives in *Amblystegium* by Husnot in *Muscologia Gallica*, in which he is followed by Dixon and Jameson. Here again the sum of the characters should decide the position of the plant. It appears to me that the very general hypnoid facies, the paraphyllia and the inflated alar cells, together with leaf cells otherwise not entirely of the *Amblystegium* type, ought to exclude it.

De Notaris, Mitten, Kindberg, and Braithwaite extend the limits of the genus so as to include several other groups of the Hypnaceæ. With these proposals I cannot agree unless we are content to go back to the comprehensive idea of the genus *Hypnum*. Should I go as far as these authors propose, I can see no reason why I should not include all the Hypnaceæ. The species of *Limnobium*, for example, are, I think, quite as closely related to the plants included by Braithwaite in *Eu-Amblystegium* as are the species of *Calliergon*, which he refers to *Amblystegium*. Yet the *Limnobia* are not included.

DISTRIBUTION.

I have been able to separate sixteen species. Ten of these are found both in Europe and North America. Five others, *AA. minutissimum*, *lescurii*, *compactum*, *noterophilum*, and *vacillans*, are exclusively North American. The sixteenth, *A. adnatum*, is found in North America and Japan. Of these, three, *AA. serpens*, *varium*, and *riparium*, are found in most parts of the United States and southern Canada, the first being less common than the others. *A. adnatum* is widely distributed, though not abundant, in the southeastern United States. *A. compactum* may be considered northern, though it extends south in the Rocky mountains to Colorado; *A. sprucei* has a similar distribution, though not found at as many stations; *A. fluviatile*, so far as

known, is northeastern, extending west to Minnesota, and south to Ohio and New Jersey. *A. lescurii* is Appalachian in its range. *A. kochii*, although represented in herbaria from few stations, seems to be widely distributed, being reported from Kansas, Minnesota, and the District of Columbia. *A. vacillans* appears to be eastern and northern, probably local; *A. minutissimum* is central and probably local; the other four are northern. One striking feature in this distribution is the entire absence of any distinctly southern or western forms, though the south has a good variety in *A. riparium floridanum*. It is hardly credible that there is such a dearth of *Amblystegia* in these regions as appears. No doubt further exploration in the west and south would reveal several forms.

RELATIONSHIPS.

The sixteen species here included fall into three groups, the type group of twelve species of which *A. serpens* is the center, and two small groups. One of these smaller groups contains a single species, *A. lescurii*; the other is made up of *A. riparium* and its varieties, *A. kochii*, and *A. vacillans*.

EXCLUDED SPECIES.

Several species accredited to North America have been excluded in this paper, because with the available material I have not been able to separate them from older species here given. *A. fenestratum* M. & K. is probably not an *Amblystegium*. It was described from a scrap of sterile gametophyte. *A. speirophyllum* M. & K., also sterile, is probably a form of *A. irriguum* or *varium*; *A. distantifolium* M. & K. is very near *A. irriguum*; *A. dissitifolium* M. & K. and *A. subcompactum* are, without doubt, *A. compactum*. *A. holzingeri* R. & C. is *Hypnum* (*Limnobium*) *closteri* Austin. *A. schlotthaueri* was allowed by me to stand in Barnes & Heald's *Key* as a subspecies, but on further comparison with *A. serpens*, I have been unable to separate it from that species. I have not been able to see *A. homalostegium* Jaeg. & Sauerb., a plant collected but once, in Alabama; but from the description

it is so doubtful as an *Amblystegium* that I have omitted it. *A. curvipes* Bru. & Sch., so far as N. American plants are concerned, must be referred to *A. kochii*; likewise all of the N. American specimens of *A. hygrophilum* Sch. that I have seen are referable either to *Hyp. chrysophyllum* or to *H. radicale* P. B. Some European specimens under the name *A. hygrophilum* must also be referred to Beauvois' plant, which now proves from the type material to be identical with Austin's *Hyp. bergenense* = *H. chrysophyllum*, var. *tenellum* of the L. & J. Manual. These plants are both decidedly nearer *Campylium* than *Amblystegium*, and I therefore place them there under Beauvois' old name. I am of the opinion that *A. hygrophilum*, and possibly *A. porphyrrhizum* as well, must be put with *H. radicale*. However, all the material of *A. porphyrrhizum* that I have had an opportunity to examine is only a form of *A. varium*. *A. orthocladon* P. B., from his type material, is *A. fluviatile* Sw. The disappearance of *A. orthocladon* from the list of species of *Amblystegium* removes one of the worst tangles in the genus. Illustrations and descriptions of Beauvois' types will appear elsewhere at a later date.

NOMENCLATURE.

For nomenclature I have gone back only to Hedwig's *Muscorum Frondosorum*. I do this because of a quite general disposition to make this work the starting point for the nomenclature of the Musci. If the *Species Plantarum* of Linnaeus is to be considered the datum line for all plants, then the name of Linnaeus should take the place of the name in parenthesis after *A. serpens* and *A. riparium*. In the list of works cited in the bibliography, I have included but three prior to the date of *Muscorum Frondosorum*.

ACKNOWLEDGMENTS.

I hope this paper may be the means of clearing up some, at least, of the difficulties attending the study of this genus even by bryologists. Aside from my own efforts, whatever of value it

may have is due to the kind cooperation of friendly bryologists. I gladly acknowledge the assistance thus received from many sources, without which my study would have been impossible, and here express my sense of indebtedness and my thanks for this assistance. Professor Charles R. Barnes of the University of Wisconsin, by giving to me at all times without stint his kindly interest and help in manifold ways, as well as by commanding for my use all the facilities in the power of the University for carrying on my work,¹ has placed me under the greatest obligations. To Mrs. Elizabeth G. Britton of New York, for the use of *Amblystegium* material in the Columbia University Herbarium, which she placed entirely at my command, and for many other favors; to Professor John Macoun of Ottawa, Ontario, for specimens of several forms not elsewhere available; to Professor John M. Holzinger, of Winona, Minnesota, for the use of type and other specimens; to M. Jules Cardot, of Stenay, France, for material; to Dr. B. L. Robinson, of Harvard University, for type specimens; and to Mr. Frederick V. Coville, of Washington, D. C., for books loaned, I offer my sincerest thanks.

AMBLYSTEGIUM Br. & Sch.

Amblystegium Bry. Eur. Monog. *Amblystegium*. 1853.

Hypnum pp. plur. auct.

Leskea pp. plur. auct.

Gametophyte bisexual rarely unisexual, varying in size from very minute to very large and robust; bright green, dark dull green, yellowish green to yellow or sometimes bronze; prostrate, creeping, decumbent, ascending or erect: stems for the most part slender, soft, occasionally rigid; abundantly and commonly irregularly branched, rarely subpinnate; with or without central strand; sometimes obscurely angled; branches flexuous, ascending or erect: leaves five to eight-ranked, generally spreading

¹ Among the type material which I have consulted none was more useful than specimens from the herbarium of Palisot de Beauvois. All his American types have been sent to the University of Wisconsin for examination through the courtesy of Dr. J. Briquet, curator of the Delessert Herbarium of Geneva, Switzerland. These types will all be studied and illustrated by figures in the course of a few months.

in all directions, sometimes complanate; widely spreading to strict; narrowly lanceolate to broadly ovate, concave or flat, never auriculate or with cells abruptly inflated at the angles, more or less decurrent, wings commonly adhering to the stem when the leaves are separated; ecostate to strongly costate, costa varying from a mere trace at the base to one-third the width of the leaf and long excurrent; margins entire to serrate; cells in the middle leaf region varying from 1:2 to 1:15, hexagonal or rhomboidal, at the leaf base broader and quadrate to long rectangular.

Sporophyte minute to large, 5^{mm} to 4^{cm} long, abundant in most species: seta generally, slender, flexuous, smooth, varying from straw color to dark purple, becoming dull dirty brown with age, central strand well developed: capsule oval to cylindrical, symmetric or asymmetric, erect incurved or horizontal, ordinarily constricted under the mouth in drying, from a large or small colum, uniformly purple or brown, or of two shades, dark on convex side and light on concave side, or pale throughout; exothecium of soft tissue; peristome hypnoid, cilia in a few cases none or rudimentary, usually two to four; operculum convex to conic, usually obtusely apiculate, rarely rostellate; annulus of one to three rows of cells; spores minutely roughened, 12 to 30 μ in diameter: calyptra small, fugacious.

ANALYTICAL KEY TO THE SPECIES.

I. *Leaves ecostate or with obscure traces of a nerve.*

Alar cells oblong to linear.

Leaf entire at base, triangular lanceolate *A. minutissimum.*

Leaf papillosely serrulate over transverse cell walls, ovate, long acuminate *A. sprucei.*

Alar cells quadrate or transversely elongated.

Plants minute (1-2^{cm})

Leaves ovate, acuminate, cells irregular, short 1:2 or less.

A. confervoides.

Leaves lanceolate, long acuminate, cells regular, 1:3 or more in the middle and apical regions *A. subtile.*

Plants twice as large or more *A. adnatum.*

II. *Leaves plainly costate.*A. *Leaves with a distinct border.*

Costa joining border at apex *A. lescurii.*

B. *Leaves not bordered.** *Costate to apex or nearly so.*

Leaves acuminate, basal cells abruptly enlarged *A. irriguum.*

Leaves acuminate, basal cells not enlarged.

Serrate throughout *A. compactum.*

Entire, or obscurely serrulate above.

Acumen long, costa ceasing within it *A. varium.*

Acumen short, costa very strong, usually long excurrent.

A. noterophilum.

Leaves not acuminate, ovate to oblong lanceolate, tip blunt *A. fluviatile.*

* * *Costa disappearing at the middle or above.*

[*A. compactum* may be sought here.]

Cells near the middle of the leaf 1 : 10-15.

Leaves long acuminate, apex sharp *A. riparium.*

Leaves acute or short acuminate, apex blunt *A. vacillans.*

Cells near the middle of the leaf 1 : 8 or less.

Alar cells quadrate or transversely elongated *A. serpens.*

Alar cells oblong.

Leaves 0.9-1.2 × 0.25-0.37^{mm} *A. juratzkanum.*

Leaves 1.2-1.6 × 0.5-0.7^{mm} *A. kochii.*

AMBLYSTEGIUM MINUTISSIMUM (S. & L.) Jaeg. & Sauerb. *Plate XI.**fig. 4.*

SYNON.: *Hypnum minutissimum* Sulliv. Musci and Hepat. of U. S.—(78) (issue of 1871). 1856.—Sulliv. & Lesq. Icon. Musc. 195. *pl.* 120. 1864.—Lesq. & James Man. Mosses of N. Am. 371. 1884.

Amblystegium minutissimum Jaeg. & Sauerb. Adumb. 2 : 547.—Macoun & Kindberg Cat. Can. Pl. 6 : 216. 1892.

EXSICCATI: *Hypnum confervoides* Sulliv. Musci Allegh. 31 (in part). *Hypnum minutissimum* Sulliv. & Lesq. Musci Bor. Amer. (1st ed.) 343. (2d ed.) 520 (Herb. Wis.).

TYPE in *Herb. Sulliv.*, Cambridge, Mass.

Gametophyte bisexual, *very minute*, pale green : stems prostrate, appressed, irregularly subpinnately branched, cylindrical, 60 to 110 μ in diameter; central strand none; cortical region of one to two layers of cells, not well differentiated, walls thin, cells

6 to 8μ in diameter; cells of ground tissue 8 to 29μ diameter; branches short, 2.5 to 5^{mm} , erect or spreading: *leaves linear lanceolate*, 90μ wide by 340μ long, varying in width from 70 to 105μ and in length from 280 to 400μ , *usually widest at very base*, tapering regularly to apex, point slender, entire at base, subdenticulate from below the middle to the apex or distinctly denticulate in the upper third, remote, open, spreading in all directions, ecostate or with a second layer of cells in costal region of basal fifth; leaf cells parenchymatous at base, soon becoming prosenchymatous above, *short rectangular in alar region*, averaging 7.5 by 18μ , shorter near the middle of base, occasionally quadrate, 6.7μ in diameter, becoming linear toward middle of the leaf, 5.6 by 40μ , occasionally reaching the extreme length of 60μ , rectangular, rhombic quadrangular or hexagonal; above the middle all prosenchymatous, many slightly vermicular, in the apical region shorter, 5.6 by 34.5μ , occasionally reaching 42μ in length; perichætal leaves long acuminate from an ovate base, coarsely and irregularly dentate above, inner larger than stem leaves, reaching 200μ wide by 750μ long.

Sporophyte small, 5^{mm} long: seta reddish brown below, pale above, 70 to 80μ in diameter, central strand of few rows of cells 15 to 18μ in diameter, cortex of one or two layers of cells 6 to 18.5μ in diameter, cells of ground tissue 9 to 17μ : capsule minute, 0.5^{mm} in length including the operculum, straight or slightly cernuous, oval, occasionally obovate, 1:2, erect, inclined or pendulous, strongly contracted under the mouth, when dry turbinate; cells of exothecium parenchymatous, regular, short rectangular, quadrate, or slightly transversely elongated, average size 20μ wide by 23μ long, walls thin, 1 to 2.5μ thick, two or three rows of cells under the peristome transversely elongated, 18 by 11μ ; stomata few, two to six, 21.5μ wide by 26μ long: peristome teeth pale with narrow hyaline border, transversely striate on the back of lower three-fifths, hyaline and papillose above; endostome equaling teeth, membrane about one-half the length of segments, the latter slender, pale, not open along the keel, finely papillose, as are the 1 or 2 slender nodose cilia which equal the segments;

operculum high conic or rostellate from a conic base; annulus of one or two rows of cells, persistent: spores pale, minutely roughened, 8 to 13μ in diameter: calyptra not seen.

HAB.: Growing on limestone rocks in shaded ravines, forming thin, loose patches over the substratum; in company with *Thuidium pygmæum*. Type locality, central and southern Ohio.

Northeastern U. S.: Ohio (Sullivant), Penn., very rare.

A very delicate plant, easily confounded with *A. sprucei* and *A. confervoides*. The leaf characters alone, however, should in most cases be sufficient to separate these three species. In *A. confervoides* the leaf cells are comparatively short and irregular throughout, with a large number in the alar regions quadrate or triangular; while in *A. minutissimum* the leaf cells are much elongated throughout, with the longest cells in the middle of the leaf. *A. sprucei*, while its leaf cells are decidedly elongated throughout, is distinguished from *A. minutissimum* by the leaves papillosely serrulate at base with the longest cell at the very apex. Further, both *A. confervoides* and *A. sprucei* have the widest point of the leaf some distance above the line of insertion, while in *A. minutissimum* the widest point is at the line of insertion, in most cases.

AMBLYSTEGIUM SPRUCEI (Br.) Br. and Sch. *Plate XI. fig. 2.*

SYNON.: *Leskea sprucei* Bruch (*in litt.*) 1845. — Spruce, Lond. Jour. Bot. 180. 1845. — Wilson, Bry. Brit. 330. 1855 (3 ed.).

Hypnum sprucei Bruch (*in litt.*) 1845. — C. Mueller, Syn. Musc. Frond. 2: 415. 1851. — Lesq. & James, Man. Moss. N. Am. 372. 1884.

Amblystegium sprucei Bruch & Schimper, Bry. Eur. Amblystegium 5, *pl.* 1. 1853. — Schimper, Syn. Musc. Eur. 588. 1860 (1st ed.); 705. 1876 (2d. ed.). — Milde, Bry. Siles. 322. 1869. — Hartmann, Handb. Skand. Flora 21. 1871 (10th ed.). — Hobk. Synops. 163. 1873. — Lindberg, Musci Scand. 32. 1879. — R. du Buysson, Essai analyt. du genre Amblystegium. 1883. — Boulay, Musc. Fr. 82. 1884. — Mac. & Kindb. Cat. Can. Pl. 6: 217. 1892. — Husnot, Musc. Gall. 356. *pl.* 102, 1893. — Dixon & Jameson, Handb. Brit. Mosses 441, *pl.* 55. 1896. — Braithwaite, Brit. Moss Flora. 3: 28. *pl.* 89. 1896.

Platydictya sprucei Berkeley, Handb. Brit. Mosses 145. 1863.

EXSICCATI: *Hypnum confervoides* Drummond, Musc. Amer. (Coll. I) 190.

Hypnum sprucei Macoun, Can. Musc. 315 (Herb. Wis.).

TYPE in herb. Bruch, Berlin?

Gametophyte unisexual, minute, slender, densely cespitose, tufts bright green above, not shining, becoming yellow with

age: stems creeping and copiously irregularly branched, cylindrical, 60 to 100 μ in diameter; central strand none; cortex of one to two layers of thick walled cells, 5 to 8.4 μ in diameter; cells of ground tissue thin walled, 6.5 to 13 μ in diameter; branches simple or with few branchlets, 0.5 to 1 μ in length, ascending: leaves *lanceolate ovate-lanceolate or ovate*, mostly long acuminate, point very slender, average size 90 by 225 μ , varying in length from 100 to 400 μ and in width from 60 to 120 μ , widest in basal sixth *generally above the line of insertion*, denticulate or subdenticulate to base, *teeth in lower part of leaf formed by single or double papillæ over the transverse walls*, open erect, equally spreading, not appressed but slightly crisped when dry, usually remote, occasionally crowded, ecostate; leaf cells parenchymatous at base, prosenchymatous above, occasionally quadrate, generally long rectangular in alar region, *papillose on the margin over transverse walls*, 8.2 μ wide by 12.7 μ long, ranging in width from 5 to 9 μ and in length from 5 to 22 μ , hexagonal to linear-hexagonal in the middle of the leaf, occasionally long rectangular or rhomboidal in the margin, 7 μ wide by 27 μ long, varying in width from 4 to 8.5 μ and in length from 17 to 45 μ , linear at apex, 5.5 μ wide by 32 μ long, varying in width from 4 to 7.7 μ and in length from 21.5 to 52 μ , apical cell of leaf in most cases the longest; perichæatial leaves ovate-lanceolate, acuminate, point filiform, irregularly ciliate dentate, reaching 1^{mm} in length, ecostate, cells short rectangular at base, linear and sometimes slightly vermicular above.

Sporophyte small, 1 to 1.5^{cm} long, *reddish purple throughout at maturity*, fading with age: seta 100 to 120 μ in diameter, cortex of one to two layers of well differentiated cells 5 to 9 μ in diameter; central strand 12 to 28 μ in diameter, composed of 15 to 25 rows of cells; cells of ground tissue 6.5 to 13 μ in diameter, walls strongly thickened: capsule symmetric, rarely slightly asymmetric, erect or suberect, subglobose to ovate, 0.5 to 1.5^{mm} long by 0.25 to 5^{mm} wide, slightly or not constricted under the mouth when dry, funnelform; cells of exothecium parenchymatous, regular or irregular, triangular to hexagonal, varying from

oblong (1 : 2.5) to slightly transversely elongated (1.25 : 1), averaging isodiametric (26μ), cell walls 4 to 6μ thick, three to five rows of cells immediately below peristome with thin walls and transversely elongated, 28.8μ wide by 11μ long; stomata five to twelve, scattered, 27.5μ wide by 31.5μ long; peristome one-fourth to one-third length of sporangium, teeth pale yellow, soon becoming hyaline, transversely striate on the back in the lower two-thirds, minutely papillose above; membrane of endostome equaling segments, the latter slender, not open along the keel, equaling the teeth, sparsely papillose; cilia one or two, short, one-third the length of segments, or none; operculum large, hemispherical, mamillate, annulus of one or rarely two rows of cells: spores pale, slightly papillose, 9 to 13μ in diameter: calyptra small, split one half its length.

HAB.: On shaded rocks, earth, twigs, and decaying logs. Type locality, Pyrenees.

Europe, North America: Ontario, mountain region of Canada, Massachusetts, Montana, Idaho, Colorado, New Mexico. Not uncommon locally.

This little moss was first collected by Drummond in Canada and Blytt in Norway, but in both cases it was called *A. confervoides*. As we now know these plants there is little difficulty in distinguishing them by their microscopic leaf characters alone. *A. sprucei* is serrulate throughout and *A. confervoides* entire; the former has elongated cells in the alar regions and linear ones at the apex, while the latter has much shorter cells throughout, being isodiametric in the alar regions and about 1 : 2 at the apex. The leaf characters distinguishing *A. sprucei* from *A. minutissimum* have already been pointed out.

AMBLYSTEGIUM CONFERVOIDES (Brid.) Br. & Sch. *Plate XI. fig. 1.*

SYNON.: *Hypnum confervoides*, Bridel, *Spec. Musc.* 2:153. 1812. *Mant. Musc.* 167. 1819. Schwægrichen, *Spec. Musc. Suppl.* 1. 2:218. 1816.—Funcke, *Moost.* 58, *pl.* 39. 1820.—Huebener, *Muscol. Germ.* 667. 1833.—De Notaris, *Syllabus Musc.* 11. 1838.—Rabenhorst, *Deutschland's Krypt. Flora* 2³:292. 1848.—C. Mueller, *Syn. Musc. Frond.* 2:414. 1851. *Deutschland's Moose* 453. 1853.—Hobkirk, *Synop.* 163. 1873.—Boulay, *Musc. Fr.* 80. 1884.—Lesq. & James, *Man. Moss, N. Am.* 372. 1884.

Hypnum conferva Schwaegr. *Spec. Musc. Suppl.* 2, 1:158, *pl.* 142. 1823.

Hypnum jungermanioides Bridel, *Bry. Univ.* 2:549. 1827.

Hypnum stereodon confervoides Bridel, Bry. Univ. 2: 583. 1827.

Leskea confervoides Spruce, Lond. Jour. Bot. 4: 182. 1845.

Amblystegium confervoides Bruch and Schimper, Bry. Eur. Ambly. 6. *pl.* 2. 1853.—Schimper, Syn. Musc. (1st ed.) 590. 1860. (2d ed.) 707. 1876.—Milde, Bry. Siles. 323. 1869.—DeNotaris, Epi. Bry. Ital. 156. 1869.—Hartmann, Skand. Flora. (10th ed.) 21. 1871.—R. duBuysson Ess. anal. 9. 1883.—Hobkirk, Synop. (2d ed.) 212. 1884.—Macoun & Kindberg, Cat. Can. Pl. 6: 218. 1892.—Husnot, Musc. Gall. 357. *pl.* 102. 1892.—Dixon & Jameson, Stud. Handb. 442. *pl.* 55. 1896.—Braithwaite, Brit. Moss Fl. 3: 27. *pl.* 89. 1896.

EXSICCATI: *Amblystegium confervoides* Austin, Musc. Appl. 368 (Herb. Wis.).

Hypnum minutissimum Sulliv. & Lesq. Musc. Bor. Am. (2d ed.) 520 (Herb. Columbia Univ. in part).

Hypnum confervoides Macoun Can. Musci. 317 (Herb. Wis.).

TYPE in Herb. Bridel.

Gametophyte bisexual, small, cespitose, in thin closely adhering patches, dark green: stems very slender, 60 to 90 μ in diameter, not angled, closely and subpinnately branched; branches 0.5 to 1^{cm} long, erect or ascending; central strand none; cortex of two layers of cells, 4.5 to 10.5 μ in diameter, differentiated from ground tissue only by the size of cells, those of the latter tissue 9 to 14 μ in diameter, thick walled: leaves remote, ovate to ovate lanceolate, 105 μ wide by 255 μ long, varying in width from 80 to 130 μ and in length from 200 to 300 μ , attaining their greatest width in the basal sixth but above the line of insertion, straight or rarely falcate, acute or acuminate, *acumen usually stout*, erect spreading, appressed when dry, margin entire, rarely irregularly subdenticulate, ecostate; leaf cells parenchymatous at base and in the margins in the lower half, prosenchymatous in median portion of lower half and throughout all of the upper half, cells in alar region *irregular, quadrate, triangular, or slightly transversely elongated, about three rows extending up the leaf five to ten cells*, 8.2 μ wide by 7.5 μ long, varying from 7 to 10.3 μ long and from 6 to 9.4 μ wide, cells above becoming elongate rectangular (1:2-4), cells in the median and apical regions sometimes regular, oval to elliptical hexagonal, more or less flexuose, *oftener irregular, oval, triangular, hexagonal, or rhomboidal*, 7 μ wide by 21.5 μ long,

ranging in length from 15 to 28 μ and in width from 4 to 10.5 μ ; perichæatial leaves elongate lanceolate from a broadly ovate base, abruptly contracted above into a narrow acumen which varies in length from one half the body of the leaf to its full length, denticulate especially at the base of the acumen, ecostate or with very narrow thin costa in the lower third.

Sporophyte small, .75 to 1.5^{cm} long: seta reddish-brown, 90 to 120 μ in diameter, cortex of one or two layers of cells 4 to 10 μ in diameter, central strand composed of twelve to twenty-five rows of cells 15 to 30 μ in diameter, capsule symmetric or slightly asymmetric, suberect to almost horizontal, ovate or cylindrical, not contracted below mouth when dry, incurved, dark dull brown; exothecium cells parenchymatous, oblong rectangular, 21.5 μ wide by 34 μ long, varying from 13 to 26 μ wide and from 17 to 43 μ long, lateral walls 3 to 6 μ thick, three rows of cells below the mouth hexagonal isodiametric or transversely elongated (17 μ); stomata few, six to ten, scattered, 28.5 μ wide by 31 μ long; teeth of peristome yellow with narrow hyaline border striæ, on the back transverse in the lower three-fourths, above this oblique or longitudinal, giving place finally to rows of long papillæ; endostome light yellow, membrane occupying more than half its entire height; segments strongly carinate, opened slightly along the keel between the articulations, finely papillose, not equaling the teeth, cilia one or two, generally shorter than the segments, sometimes not more than one-third their length; operculum apiculate from a convex or conic base, usually as broad as the capsule; annulus of one or two rows of cells: spores pale, finely tuberculate, 8.5 to 15 μ in diameter: calyptra usually shorter than capsule, split little more than half its length.

HAB.: On bowlders in moist woods or on shaded moist limestone cliffs. Type locality Austria.

Europe, Asia, North America: New England, New Brunswick, Ontario, Ohio, along the great lakes, and Rocky mountains. Not abundant.

A small plant, very generally confused with *A. sprucei* and *A. subtile* by American collectors and writers. From the former it may usually be readily

distinguished by characters referred to under that species; from the latter it is distinguished by its smaller cells in the alar region and shorter and more irregular cells in the middle and apical regions. Further, *A. subtile* shows a distinct trace of costa in most leaves and has its parts in general one-half larger.

AMBLYSTEGIUM SUBTILE (Hedw.) Br. & Sch. *Plate XI. fig. 3.*

SYNON.: *Hypnum minimum* Haller, Hist. Stirp. Helvet. 1768.

Leskea subtilis Hedwig, Musc. Frond. 4: 23. *pl. 9.* 1797. Sp. Musc. 221. 1801.—Swartz, Musci. Sueciæ 69. 1799.—Roth, Fl. Germ. 3: 335. 1800.—Bridel, Musc. Recent. 3: 44. 1801. Bry. Univ. 2: 309. 1827.—Weber & Mohr, Bot. Tasch. 250. 1807.—Røehling, Deutschl. Flora (2d ed.) 3: 87. 1813.—Wahlenberg, Fl. Carpat. 356. 1814.—Schwægrichen, Sp. Musc. Suppl. 1. 2: 176. 1816.—Martius, Flora crypt. Erlang. 48. 1817.—Funck, Deutsch. Moos. 55. *pl. 36.* 1820.—Hübener, Musc. Germ 587. 1833.—DeNotaris, Syl. Musc. Ital. 62. 1838.—Hartmann, Skand. Fl. (10th ed.) 21. 1871.

Hypnum subtile Hoffmann, Deutschl. Flora 2: 70. 1796.—Smith, Flora Brit. 3: 1277. 1804.—Palisot de Beauvois, Prodrome 71. 1805.—C. Mueller, Syn. Musc. Frond. 2: 415. 1851. Deutsch. Moos. 454. 1853.—Sullivant, Musci and Hepat. of U. S. 77. 1856.—Lesq. & James, Man. Moss. N. Am. 372. 1884.

Neckera tenuis Bridel, Mant. Musc. 138. 1819.

Hypnum (Stereodon) serpens var. *subtilis* Bridel, Bry. Univ. 2: 649. 1827.

Amblystegium subtile Bruch & Schimper, Bry. Eur. Ambly. 4. *pl. 1.* 1853.—Schimper, Synop. Musc. Eur. (1st ed.) 589. 1860. (2d ed.) 706. 1876.—Milde, Bry. Siles. 322. 1869.—DeNotaris, Epil. Bry. Ital. 155. 1869.—Hartmann, Skand. Fl. (10th ed.) 21. 1871.—Lindberg, Musc. Scand. 32. 1879.—R. du Buysson, Ess. Anal. 1883.—Macoun & Kindberg, Cat. Can. Pl. 6: 217. 1892.—Husnot, Musc. Gall. 356. *pl. 102.* 1894.

EXSICCATI: *Hypnum subtile* Sull. & Lesq., Musc. Bor. Amer. (1st ed.) 342. (2d ed.) 519.—Macoun, Can. Musc. 316. (Herb. Wis.).

Amblystegium subtile Austin, Musc. App. 369. (Herb. Wis.).

TYPE in herb. Haller, Berne, Switzerland.

Gametophyte bisexual, small, widely cespitose, dark green, coherent in tangled felts: stems repent, slender, 60 to 110 μ in diameter, 1 to 3^{cm} long, radiculose to the apex, branched, cylindrical; central strand none; cortex of one or two layers of small cells 6.5 to 10.7 μ in diameter; cells of ground tissue 13 to 21.7 μ in diameter, largest at the center, cell walls uniformly thickened in all tissues with the occasional exception of cells in the outer cortical layer where the wall is thin; branches

numerous, short, 0.5 to 1^{cm} long, erect: leaves not crowded, lanceolate from an ovate base, sometimes linear-lanceolate, *long acuminate*, acumen very slender, 130 μ wide by 440 μ long, ranging in width from 100 to 150 μ and in length from 250 to 500 μ , reaching greatest width in basal fifth, but some distance above the line of insertion, straight or more or less falcate, equally spreading, suberect or subsecund, appressed when dry except the slender points, *entire, with only a trace of costa in basal fifth, this sometimes double or branching* or very rarely wanting; leaf cells parenchymatous at base and along margins in lower half, elsewhere prosenchymatous, *cells at basal angles regular, quadrate or slightly transversely elongated, becoming short rectangular toward the middle, 11 μ wide by 9.5 μ long*, varying in width from 8.5 to 16 μ , and in length from 6.5 to 15 μ , cells in the middle of the lower third oblong, about 1:1.5, those of the middle region irregularly hexagonal, occasionally slightly flexuose, 8.2 μ wide by 26 μ long, ranging in width from 6.5 to 10 μ and in length from 19 to 32 μ , cells in apical region much as in median region, but regularly somewhat longer, the terminal cell in most cases being the longest in the leaf blade, varying in width from 6.5 to 9.5 μ and in length from 15 to 44 μ , averaging 8 μ wide by 30.5 μ long; outer perichætal leaves abruptly long acuminate from a broadly ovate base, acumen equaling the body, ecostate or with a trace of costa at base, inner leaves much larger, linear lanceolate, abruptly acuminate, acumen one-half the length of the body, costate to middle or beyond, costa thin but distinct, all entire.

Sporophyte small, 1^{cm} long, cinnamon brown: seta flexuous in upper third, 120 to 150 μ in diameter, central strand 16 to 19 μ in diameter, composed of ten to eighteen rows of cells, cortex of two or three layers of cells, with walls moderately thickened, 6.5 to 13 μ in diameter, cells of ground tissue 13 to 21.5 μ in diameter, largest near the central strand: capsule oblong cylindrical, 1 to 1.5^{mm} long including operculum, symmetric or moderately incurved, erect, becoming more or less inclined by the bending of the seta, only slightly contracted under the mouth in drying, collum shrivelling and becoming wrinkled, wall of

capsule thin and flaccid, cells of exothecium parenchymatous, varying from quadrate to oblong, $22\ \mu$ wide by $46\ \mu$ long, varying in width from 13 to $26\ \mu$ and in length from 21 to $80\ \mu$, walls uniformly thickened, $4\ \mu$, three to five rows of cells below the mouth hexagonal, 13 to $21.5\ \mu$ in diameter, stomata eight to fifteen, scattered, $27\ \mu$ wide by $35\ \mu$ long; peristome teeth pale yellow with hyaline border, lance-linear, striæ on the back transverse in lower two thirds, oblique above or replaced by irregularly scattered papillæ, endostome equaling the teeth, one-third to one-half the length of the segments, the latter linear, carinate, open along the keel between the articulations, sparsely papillose, cilia very rudimentary or none, operculum high convex to conic, obliquely apiculate; annulus of one or two rows of cells: spores pale, 10 to $16\ \mu$ in diameter: calyptra equaling the capsule, split more than half its length.

HAB.: On bases of tree trunks, chiefly maple, beech and willow; rarely on shaded rocks. Type locality Switzerland.

Europe, Asia, North America: New England, New York, New Jersey, Ontario, and westward along the Great Lakes to Wisconsin and Minnesota. Not rare.

This with the preceding three species, on account of their uniformly small size, form a group, all of which are usually easily distinguished from all other members of the genus, though small forms of *A. adnatum* and *A. serpens* may sometimes be mistaken for them. The former has leaves proportionately broader, more abruptly and shorter pointed, with cells very regular and uniformly larger in upper parts of leaf. The latter usually shows a distinct costa in the lower third of the leaf.

AMBLYSTEGIUM ADNATUM (Hedw.) Aust. *Plate XI. fig. 5.*

SYNON.: *Hypnum adnatum* Hedwig, *Spec. Musc.* 248. *pl. 64. f. 5-10.* 1801.—Palisot de Beauvois, *Prodr.* 61. 1805.—Bridel, *Spec. Musc.* 2: 160. 1812. *Mant. Musc.* 168. 1819.—Schwægrichen, *Spec. Musc. Suppl.* 1. 2: 215. 1816.—C. Mueller, *Syn. Musc. Frond.* 2: 339. 1851.—Sullivant, *Musc. and Hepat. of U. S.* 78. 1856. *Icon. Musc.* 197. *pl. 121.* 1864.—Lesquereux & James, *Man. Moss. N. Am.* 375. 1884.

Hypnum (Stereodon) adnatus Bridel, *Bry. Univ.* 2: 591. 1827.

Amblystegium adnatum Macoun & Kindberg. *Cat. Can. Pl.* 6: 220. 1892.

EXSICCATI: *Hypnum adnatum* Sulliv. & Lesq., Musc. Bor. Amer. (1st ed.) 344. (2d ed.) 521, 522.—Macoun, Can. Musc. 322, 323 (Herb. Wis.).

Amblystegium adnatum Austin, Musc. App. 370. 1870.

TYPE in Herb. Hedwig.

Gametophyte bisexual, depressed, in wide thin mats, yellowish, pale green or sometimes dark green, closely adhering to the substratum: stems irregularly branching, creeping, 2 to 4^{cm} long, slightly flattened, the two diameters usually 4:5, 140 by 175 μ in diameter, ranging from 100 by 125 μ to 180 by 225 μ ; central strand none; cortex of three or four layers of cells, 6.5 to 14 μ in diameter; cells of ground tissue 10 to 22.5 μ , largest near the center, cell walls noticeably thickened; branches numerous, very short, 2 to 5^{mm}, erect: leaves crowded, erect spreading, *ovate or oblong, abruptly short acuminate, acumen broad, concave, entire* or occasionally irregularly denticulate, *usually with a thin simple branched or double costa in basal fifth*, 345 μ wide by 820 μ long, varying in width from 300 to 380 μ and in length from 800 μ to more than a millimeter; leaf cells in all but alar regions prosenchymatous, *cells of basal angles regular, quadrate, slightly transversely elongated or occasionally oblong*, 13.9 μ wide by 9.2 μ long, varying from 12 to 17 μ in width and from 6.4 to 15 μ in length, toward the middle of the base *changing abruptly to long hexagonal*, almost vermicular, walls thin, usually thicker and firmer in the middle region, cells varying in width from 4.3 to 8.6 μ and in length from 28 to 58 μ , averaging 6.5 μ wide by 42.8 μ long, toward apical region gradually changing from hexagonal to rhomboidal, 8.8 μ wide by 24.6 μ long, ranging in width from 6.9 to 10.6 μ and in length from 17 to 32 μ , longest cells in the middle of the leaf; *in general the leaf cells very regular in all parts*, the alar quadrate cells sometimes extending as much as one third the length of the leaf; outer perichæatial leaves broadly ovate, gradually acuminate, acumen half the length of the body, spreading, inner leaves ovate to oblong abruptly acuminate, acumen short, one fifth to one fourth the length of the body of the leaf, strict, all irregularly denticulate to dentate above the middle and costate to the middle, costa evident,

thin, occasionally simple, usually branched near the base or double.

Sporophyte small 0.5 to 1.5^{cm} long: seta purplish below, pale above, 140 to 18 μ in diameter; central strand well differentiated, large, 35 to 58 μ in diameter, composed of thirty-five to fifty rows of cells; cortex of two to three layers of cells 4.3 to 10.7 μ in diameter, walls very strongly thickened, as are those of the ground tissue, the latter cells 12 to 17 μ in diameter: capsule oblong to obovate, incurved from an erect base, asymmetric, gradually contracted to the seta, brownish purple throughout or paler on the concave side, usually more or less constricted under the mouth and the latter dilated in drying, 1.5 to 2^{mm} long, wall thin; cells of exothecium parenchymatous on the concave side, 25.7 μ wide by 38.6 μ long, ranging in width from 17 to 28 μ and in length from 21 to 64 μ , on the convex side more or less prosenchymatous, 20 μ wide by 62 μ long, ranging from 13 to 21.5 μ wide and from 34 to 79 μ long; walls of cells from 2 to 4 μ , thicker on the concave side, three to six rows of isodiametric, hexagonal cells under the peristome 13 to 22 μ ; stomata few, eight to fourteen to the capsule, 25 μ wide by 36 μ long; peristome teeth linear-lanceolate, very slender pointed, transversely striate on the back below the middle, densely papillose above, hyaline border very narrow or none below, wider and serrate above, teeth yellow; endostome almost equaling the teeth, finely papillose in all parts, membrane narrow, one half the length of the segments, the latter lance-linear, perfect, entire, often not split along the keel, never gaping; cilia one or two, slender, nodulose, nearly equaling the segments; operculum equaling capsule in width, convex to high conic, obliquely apiculate or rostellate; annulus broad, of two to three rows of cells: spores light brown, surface minutely roughened, 8 to 12 μ in diameter: calyptra equaling the capsule, split half its length.

HAB.: On shaded rocks, occasionally at base of trees. Type locality Lancaster, Pennsylvania.

Japan, North America: New Brunswick, Ontario, region of the Rocky mountains, New England, New York, District of

Columbia, New Jersey, Ohio, West Virginia, Wisconsin, Minnesota and Texas. Not rare.

This moss has in several instances been confused with *Hypnum reptile*. The likeness between the two forms however is only in general appearance and size. Once the leaves of the two are subjected to a microscopical examination no difficulty need be experienced in separating them, the leaves of *H. reptile* being long and gradually acuminate and strongly serrate in the upper half, generally distinctly falcate and secund. Between *A. adnatum* and *A. subtile* there are occasional forms which are puzzling in the absence of the sporophyte, but usually the size of the leaf and dimensions of the leaf cells are sufficient to separate them.

AMBLYSTEGIUM SERPENS (Hedw.) Br. and Sch. *Plate XI. fig. 6.*

SYNON.: *Hypnum serpens* Hedwig, Musc. Frond. 4: 45. *pl. 18.* 1797. Spec. Musc. 268. 1801.—Swartz, Musc. Frond. Suec. 65. 1799.—Bridel, Musc. Recent. 2²: 111. 1801. Spec. Musc. 2: 243. 1812. Mant. Musc. 183. 1819. Bry. Univ. 2: 642. 1827.—Smith, Fl. Brit. 1306. 1804.—Turner, Muscologiae Hibernicae Spicilegium 169. 1804.—Palisot de Beauvois, Prodr. 70. 1805.—Schultz, Prodromus Florae Stugardiensis 322. 1806.—Weber and Mohr, Bot. Taschen. 300. 1807.—Wahlenberg, Fl. Lapp. 376. 1812. Fl. Carpat. 359. 1814.—Roehling, Deutschl. Fl. 3: 110. 1813.—Schwægrichen, Spec. Musc. Suppl. 1. 2: 260. 1816.—Martius, Cr. Erl. 15. 1817.—Hooker and Taylor, Muscologia Britannica 94. 1818.—Hooker, Flora Scotica 2: 142. 1821.—Funck, Moost. 50. *pl. 45.* 1821.—Gray, Nat. Arr. Brit. Pl. 1: 754. 1821.—Huebener, Musc. Germ. 679. 1833.—De Notaris, Syl. Musc. Ital. 10. 1838.—Rabenhorst, Deutsch. Krypt. Fl. 2³: 292. 1848.—C. Mueller, Syn. Musc. Frond. 2: 411. 1851. Deutschl. Moos. 454. 1853.—Wilson, Bry. Brit. 362. 1855. Sullivant, Musc. and Hepat. U. S. 78. 1856.—Berkeley, Handb. Br. Moss. 96. 1863.—Hobkirk, Syn. of Brit. Mosses. 163. 1873.—Boulay, Musc. Fr. 79. 1884.—Lesquereux and James, Man. Moss. N. Amer. 373. 1884.

Hypnum spinulosum Hedwig, Spec. Musc. 269. *pl. 69. f. 5-10.* 1801.

Hypnum contextum Hedwig, Spec. Musc. 273. *pl. 72. f. 5-12.* 1801.

Amblystegium serpens Bruch and Schimper, Bry. Eur. Ambly. 9. *pl. 3.* 1853.—Schimper, Syn. (1st ed.) 591. 1860. (2d ed.) 709. 1876.—Milde, Bry. Siles. 323. 1869.—De Notaris, Epi. Bry. Ital. 153. 1869.—Hartmann, Skand. Fl. (10th ed.) 20. 1871.—Hobkirk, Syn. 212. 1884.—Lindberg, Musc. Scand. 1879.—Macoun and Kindberg, Cat. Can. Pl. 6: 218. 1892.—Husnot, Musc. Gall. 357. *pl. 102.* 1893.—Dixon and Jameson, Stud. Handb. 442. *pl. 56.* 1896.—Braithwaite, Brit. Moss. Fl. 3: 23. *pl. 89.* 1896.

Amblystegium serpens subsp. *schlotthaurri* Renaud and Cardot, Bot. Cent. 51: —. 1890.

EXSICCATI: *Hypnum serpens* Sulliv. and Lesq., Musc. Bor. Amer. (1st ed. 345. (2d ed.) 523.— Macoun, Can. Musc. 318 (Herb. Wis.).

Amblystegium serpens Austin, Musc. App. 373.

TYPE probably not in existence. The plant is supposed to have been described as early as 1696 by Ray.

Gametophyte bisexual, *small or of medium size*, usually densely cespitose, occasionally in loose mats, sometimes bright green, oftener dull yellowish green: *stems prostrate, generally much branched, slender, weak*, 100 to 150 μ in diameter, 1 to 3^{cm} long; central strand well differentiated though small, 13 to 20 μ in diameter, composed of eight to fifteen rows of cells; cortex of one or two layers of cells with walls moderately thickened, cells 6.5 to 13 μ ; cells of ground tissue 13 to 30 μ in diameter; branches ascending or erect, flexuous with few branchlets .5 to 1.5^{cm} long: leaves ovate lanceolate to narrowly lanceolate, 320 μ wide by 800 μ long, varying in width from 260 to 360 μ , and in length from 500 μ to more than a millimeter, usually serrulate in upper two-thirds, flat or concave at base, *generally long acuminate*, occasionally subsecund, costate, *costa thin, weak, reaching to near the middle*, occasionally beyond (three-fifths the length of the leaf), or sometimes very short, occupying one sixth the leaf base at the line of insertion, 25 to 35 μ wide, maximum width of leaf in basal sixth, upper two fifths a long slender acumen, leaf gradually widening below, when moist erect or open-spreading, in the dry condition either open or appressed; leaf cells parenchymatous below, those of the alar regions short rectangular to slightly transversely elongated, 17.4 μ long by 15.3 μ wide, varying from 13 to 18 μ in width and from 15 to 19 μ in length, in the costal region of base cells usually longer, the quadrate alar cells extending up to widest point of the leaf, there giving place to rectangular ones which in turn are soon succeeded by regularly hexagonal cells; those of middle lamina 11 μ wide by 42 μ long, ranging from 9 to 13 μ wide and from 30 to 55 μ long, the longest cells however usually being found in the long slender acumen, where they sometimes reach 60 μ , varying in width from 11 to 13 μ and in length from 40 to 60 μ , averaging 12 μ wide by 45 μ long; perichætal leaves triangular lanceolate to oblong, erect, some-

times abruptly acuminate, acumen short, broadly costate to apex; outer triangular lanceolate, erect or slightly spreading; inner much larger, oblong, all costate, costa distinct, excurrent, forming a slender short acumen.

Sporophyte small to medium, 1^{cm} (rarely less) to 3.5^{cm} long: seta slender, 180 to 240 μ in diameter, flexuous above, reddish brown at base, stramineous above; central strand well differentiated, 25 to 33 μ in diameter, composed of thirty to forty rows of cells; cortex of three to five (usually four) layers of cells 6.5 to 13 μ in diameter; cells of ground tissue 13 to 21.5 μ : capsule 1.5 to 3^{mm} long, cylindrical or occasionally thickest at the mouth, tapering regularly from there to the seta, asymmetric, suberect to strongly incurved, collum one sixth the length of the sporangium, reddish or yellowish brown, frequently of two shades, becoming dull dirty brown with age, when empty frequently strongly incurved and constricted below the mouth; cells of the exothecium more or less prosenchymatous on the convex side, 23.5 μ wide by 51.5 μ long, varying from 13 to 37 μ wide and from 30 to 82 μ long, parenchymatous on the concave side, 25.5 μ wide by 38.5 μ long, ranging in width from 17 to 39 μ and in length from 21 to 65 μ , cell walls 3 to 4 μ thick, three to five rows of cells under peristome isodiametric hexagonal, sometimes transversely elongated, 10.5 to 25 μ in diameter; stomata eighteen to twenty-five, scattered, 42 μ wide by 48 μ long, ranging from 37 to 47 μ wide and from 42 to 56 μ long; peristome teeth lanceolate, dull brown below, pale above, marginal serrulate above, transversely striate on the back to beyond the middle, above this point faintly papillose; endostome equaling or slightly exceeding the teeth; membrane two thirds the length of the segments, the latter lanceolate, carinate, split along the keel between the articulations though scarcely gaping, papillose, as are also the one to three nodulose cilia which scarcely equal the segments; operculum apiculate from a highly convex or conic base; annulus broad of two or three rows of cells: spores finely papillose, light brown, 12 to 15 μ in diameter: calyptra equaling capsule or shorter, split one half its length.

HAB.: On earth in moist places, at roots of trees and on decaying wood. Type locality England.

Found all over the world. Widely distributed in North America though less common than *A. varium*.

Amblystegium serpens stands as the type species around which the other members of the genus group themselves. It is a remarkably variable species though having few well marked varieties. It is most easily confounded with two of its close relatives *A. juratzkanum*, which by many is made a variety of it, and *A. varium*. *A. juratzkanum* is distinguished by having its leaves widely spreading and having its parts uniformly larger and its leaf cells longer at the base of the leaf. *A. varium* is generally a larger plant than *A. serpens*, has broader leaves, somewhat smaller cells throughout, and commonly has its leaves costate well towards the apex. Notwithstanding the differences in the well-marked forms, there are forms between them which will never cease to puzzle bryologists.

AMBLYSTEGIUM JURATZKANUM Schimp. *Plate XI. fig. 7.*

SYNON.: *Amblystegium juratzkanum* Schimper, Syn. (1st ed.) 693. 1860. 2d ed.) 710. 1876.—Milde, Bry. Siles. 327. 1869—Hartmann, Skand. Fl. (10th ed.) 19. 1871.—Husnot, Musc. Gall. 358. *pl. 102.* 1893. Flora Batavia, *pl. 939.*

Hypnum juratzkanum Boulay, Musc. Fr. 74. 1884.

Amblystegium serpens juratzkanum R. duBuysson, Étude du genre Amblys. 18. 1889.

Amblystegium juratzkæ Macoun & Kindberg, Cat. Can. Pl. 6:218. 1892.

Amblystegium juratzkæ Braithwaite, Brit. Moss Fl. 3: 25. *pl. 91.* 1896.

EXSICCATI: *Hypnum juratzkæ* Macoun, Can. Musc. 466.

TYPE in herb. Schimper.

Gametophyte bisexual, of medium size, loosely *cespitose*, bright green, becoming yellow below with age: stem slender, 2 to 4^{cm} long, 120 to 180 μ in diameter, cylindrical, prostrate, branched; central strand small and poorly developed or none, when present 8 to 17 μ in diameter, composed of three to ten rows of cells; cortex thin, not well differentiated, of one layer (rarely two) of cells 8.5 to 17 μ in diameter; cells of ground tissue 13 to 26 μ ; primary branches few, prostrate; branchlets numerous, erect or ascending: *leaves linear lanceolate* to ovate lanceolate, *narrowly long acuminate*, *acumen equaling or exceeding the body of the leaf*, attaining greatest width in basal fifth, *serrulate to the base*, costate, costa

thin but distinct below, extending one half to two thirds the length of the leaf, one seventh to one fifth the entire width of leaf base at line of insertion, *widely spreading in both moist and dry conditions*, flat and straight or slightly concave at base, average leaves 300μ wide by 1050μ long, varying in width from 250 to 370μ and in length from 800 to 1200μ , leaves in smaller forms approaching those of *A. serpens* in form and size and in the larger forms reaching a length of 1400 to 1500μ ; leaf cells short oblong, rectangular, or rarely quadrate across the base, prosenchymatous above, hexagonal in the middle, *generally linear-hexagonal in the upper half of the acumen, longest cells usually found above the end of the costa*, alar cells 13.4μ wide by 24.4μ long, varying in width from 10 to 17μ and in length from 17 to 40μ , towards the middle 11.3μ wide by 52.4μ long, ranging in width from 8.5 to 13μ and in length from 40 to 70μ , and at the apex usually a little longer and narrower, 10.2μ wide by 63μ long, varying in width from 8.5 to 12.5μ and in length from 40 to 85μ ; perichætical leaves triangular lanceolate or ovate lanceolate, pale, strict, short acuminate by the excurrent costa.

Sporophyte of medium size, 1.5 to 3^{cm} long: seta 180 to 300μ in diameter, flexuous above, red at base, yellow or pale brown above; cortex of two to four layers of cells 6.4 to 17μ in diameter; central strand well developed, 35 to 45μ in diameter, composed of fourteen to forty-five rows of cells; cells of ground tissue 13 to 35μ ; capsule 2.5 to 3.5^{mm} long, slender, cylindrical, asymmetric, either moderately or strongly incurved from an erect base, slightly constricted under the mouth when dry, pale at maturity, usually light brown on the convex side and yellow on the concave side, frequently becoming darker colored when empty, collum slender, about one-fourth the length of the sporangium; exothecium cells mixed prosenchymatous and parenchymatous on the convex side, 34μ wide by 90μ long, varying in width from 17 to 51.5μ and in length from 47 to 110μ , parenchymatous on the concave side, 38.5μ wide by 64μ long, ranging from 21.5 to 56μ wide and from 30 to 90μ long, cell walls variable, 2 to 6μ thick, two to four rows of cells

under the peristome smaller, hexagonal or transversely elongated, from 13 to 26 μ long and from 18 to 36 μ wide; stomata twenty-five to thirty-five to the capsule, scattered, 40 μ wide by 50 μ long; teeth of peristome lanceolate, pale yellow, long acuminate, margined, margin narrow at base becoming gradually wider above, reaching its greatest width about the middle, teeth serrulate above, transversely striate to the middle, here the striæ becoming irregular, some being oblique and some perpendicular, farther up the striæ replaced by papillæ which are scattered irregularly or arranged in parallel rows; endostome equaling the teeth or a little shorter, membrane one-half to three-fifths the length of the segments, the latter lanceolate, very slender pointed, perfect, carinate, open along the keel between the articulations but not gaping, membrane and segments finely and densely papillose as are the one to three stout cilia, the latter shorter than the segments; operculum convex to conic, apiculate; annulus of two rows of cells: spores light brown, finely punctulate, 15 to 18 μ in diameter: calyptra two-thirds the length of the capsule, split half its length.

HAB.: On moist stones or earth. Type locality lower Austria.

Europe, Asia, North America: District of Columbia, Ontario, Wisconsin, Montana, Idaho, and British Columbia. Not common.

This species is very closely related to *A. serpens* by all its characters and small forms of it are difficult to distinguish from the latter. It is commonly of larger size throughout and has its leaf cells at base more commonly elongated. The general habit of the plant will usually aid in identifying it; the leaves are always widely spreading but not bent as is the case with *Campylium chrysophyllum*. From small forms of *A. riparium*, especially *A. riparium floridanum*, it may be found troublesome to separate it. The leaves of forms of *A. riparium* are entire, while those of *A. juratzkanum* are serrulate to the base.

AMBLYSTEGIUM COMPACTUM (C. Muell.) Aust. *Pl. XI. fig. 8.*

SYNON.: *Hypnum compactum* C. Mueller, *Syn. Musc. Frond 2: 408.* 1851.—Sullivant, *Icon. Musc. 201. pl. 123.* 1864.—Lesquereux & James, *Man. Moss. N. Amer. 375.* 1884.

Amblystegium serratum Bruch & Schimper, *Bry. Eur. Ambly. 11.* 1853.

Stereodon compactus Mitten, Jour. Linn. Soc. 8: 43.

Amblystegium compactum Macoun & Kindberg, Cat. Can. Pl. 6: 1892.

EXSICCATI: *Amblystegium compactum* Austin, Musc. App. 372; Macoun, Can. Musc. 324 (Herb. Wis.).

Hypnum serpens var. *compactum* Hooker in Drummond's Musc. Amer. 188.

TYPE in Herb. Hooker, Kew.

Gametophyte bisexual, of medium size, usually in dense tufts from 0.5 to 2.5^{cm} deep, sometimes forming loosely woven mats, pale green above, becoming yellow or rust colored below with age: stems slender 2 to 3^{cm} long, 120 to 190 μ in diameter, rarely reaching 220 μ , obscurely five angled, erect, ascending or occasionally almost prostrate, soft and flexible when moist, *fragile when dry, fasciculately branched*, tomentose radiculose to near the apex; central strand small, 3 to 6 μ in diameter, of four to seven rows of cells, cells of ground tissue 13 to 32 μ in diameter, cortex of one or two layers of cells 4.5 to 13.6 μ , all tissues *having thin walls*; branches slender, short, 0.4 to 1^{cm} long, erect with tips generally inclined or curved, closely foliate; leaves lanceolate to ovate lanceolate, *more or less long and narrowly decurrent*, attaining greatest width in the basal fifth, usually near the line of insertion, 260 μ wide by 780 μ long, varying in width from 180 to 350 μ and in length from 550 to 1000 μ , in extremely large leaves reaching 500 μ wide by 1200 μ long, erect spreading crowded, not appressed when dry, straight or slightly falcate, gradually acuminate, acumen broad to tip, costate, costa generally *percurrent or nearly so*, rarely ceasing just above the middle, strong at base, sometimes thin and divided above or disappearing entirely for a short distance, one-fifth to one-sixth the leaf base at line of insertion, 30 to 50 μ wide; dentate or rarely almost entire at the base, *teeth formed of a single or a double papilla over the transverse wall or by the protrusion of the adjoining corners of the marginal cells above*, the teeth being of the ordinary form, but frequently recurved; leaf cells parenchymatous across the base, somewhat abruptly and regularly prosenchymatous above, those of the alar regions (excluding the decurrent wing) quadrate to short rectangular, 8.6 μ wide by 11.7 μ long, ranging from 7 to 12.5 μ wide and from 8.5 to 19 μ long, those near the

costa being somewhat longer, the marginal row in the middle of the leaf rhomboidal with the marginal wall regularly thicker than (often twice as thick as) other walls of the same cell or the walls of other cells of the middle lamina, the latter oval to linear hexagonal, 6.5μ wide by 47.6μ long, varying in width from 4.7 to 8.6μ and in length from 38 to 64.5μ , at the apex of the leaf cells shorter and broader, sometimes irregular, 7.9μ wide by 20.8μ long, ranging from 5 to 8.6μ wide and from 15 to 30μ long; perichæcial leaves oblong lanceolate, abruptly acuminate, acumen one-fifth the length of the body, serrulate in the upper third, entire below, costate, costa narrow, percurrent or excurrent.

Sporophyte small or medium, 1 to 3^{cm} long: seta slender, 130 to 160μ in diameter, brown or purplish brown throughout, or paler above; central strand small, 17 to 22μ in diameter, of six to eight rows of cells, cortex of one or two layers of cells 4 to 11μ in diameter, beneath these the cells of the ground tissue abruptly larger, 15 to 30μ : capsule 1.5 to 3^{mm} long, symmetric or asymmetric, erect or inclined, chestnut brown to brownish purple, constricted under the broad and slightly dilated mouth when dry; exothecium cells parenchymatous, generally regular, quadrate to short rectangular, walls very thick, 5 to 9μ , cells 21μ wide by 31.5μ long, varying in width from 11 to 34μ and in length from 21 to 60μ , four to six rows of hexagonal transversely elongated cells under the peristome 24μ wide by 14.3μ long; stomata twelve to thirty to the capsule, 30μ wide by 38.5μ long; collum prominent, long, one-half the length of the sporangium; teeth of peristome lanceolate to linear lanceolate, yellow below, paler and narrowly margined above, densely and finely papillose on the back above, transversely striate in the lower half or occasional areas in lower half covered with papillæ arranged in transverse rows; endostome pale yellow, finely papillose, shorter than the teeth, membrane equaling the segments or nearly so, the latter lanceolate, carinate, open along the keel between the articulations, not gaping; cilia one or two, short and broad or obsolete; operculum high conic or apiculate from a convex base,

broad; annulus of one or two rows of cells: spores papillose, 15 to 21.5μ in diameter: calyptra small, one-third to one-half the length of the capsule, split one-half to three-fifths its length.

HAB.: On decayed wood, at the bases of trees in swamps or along streams. Type locality North America (Drummond).

North America: New Brunswick, Ontario, Lake Huron, Pennsylvania, New York, Wisconsin, Canadian Rocky mountains, Montana, Nevada, Utah, Colorado, California, and Washington. Widely distributed and not uncommon.

A well marked species, the habit of growth in more or less dense tufts being sufficient ordinarily to separate it from all of its relatives; further the strong and peculiar serration of its leaves mark it at once. After carefully examining all the material known to exist in America of *A. subcompactum* Kindb. and *A. dissitifolium* Kindb., I have been unable to separate them from *A. compactum*, though they differ from the typical form in some small degree.

AMBLYSTEGIUM VARIUM (Hedw.) Lindb. *Plate XI. fig. 10.*

SYNON.: *Leskea varia* Hedwig, Spec. Musc. 216. *pl. 53. f. 15-20.* 1801.—Bridel, Spec. Musc. 2: 71. 1812. Mant. Musc. 146. 1819.—Schwægrichen, Spec. Musc. Suppl. I. 2: 174. 1816.

Hypnum varium Palisot de Beauvois, Prodr. 72. 1805.

Hypnum orthocladon Bridel, Spec. Musc. 2: 241. 1812. Mant. Musc. 182. 1819. Bry. univ. 2: 537. 1827.—Schwægrichen, Spec. Musc. Suppl. I. 2: 262. 1816.—Sullivant, Musc. and Hepat. of the U. S. 78. 1856. Icon. Musc. 199. *pl. 122.* 1864.—Lesquereux & James, Man. Moss. of N. Amer. 374. 1884.—Not of Palisot de Beauvois.

Hypnum debile Bridel, Spec. Musc. 2: 250. 1812.

Hypnum (Stereodon) varius Bridel, Bry. univ. 2: 652. 1827.

Hypnum serpens $\beta.$ *varium* C. Mueller, Syn. Musc. Frond. 2: 412. 1851.

Amblystegium radicale Bruch & Schimper, Bry. Eur. Ambly. 10. *pl. 4.* 1853.—Schimper, Syn. Musc. Eur. (1st ed.) 592. 1860. (2d ed.) 711. 1876.—Milde, Bry. Siles. 324. 1869.—De Notaris, Epil. Bry. Ital. 154. 1869.—Hobkirk, Syn. (2d ed.) 213. 1884.

Hypnum radicale Wilson, Bry. Brit. 363. *pl. 25.* 1855.—Sullivant, Musc. and Hepat. of the U. S. 78. 1856.—Berkeley, Handb. Brit. Moss. 97. 1863.—Hobkirk, Syn. 164. 1873.—Boulay, Musc. Fr. 73. 1884.—Lesquereux & James, Man. Moss. of N. Amer. 373. 1884.—Not of Palisot de Beauvois.

Stereodon varius Mitten, Jour. Linn. Soc. 8: 43. 1864.

Amblystegium varium Lindberg, Musc. Scand. 32. 1872.—R. du Buysson Étud. gen. Ambly. 1883.—Macoun & Kindberg, Cat. Can. Pl. 6: 219. 1892.

— Husnot, *Musc. Gall.* 359. *pl.* 103. 1893.— Dixon & Jameson, *Stud. Handb.* 443. 1896.— Braithwaite, *Brit. Moss Fl.* 3 : 22. *pl.* 88. 1896.

Amblystegium varium var. *lesquereuxii* Renaud & Cardot, *Flora Miquel-
onense* 53. 1888.

Amblystegium orthocladon Macoun & Kindberg, *Cat. Can. Pl.* 6 : 219
1892.

Amblystegium porphyrrhizum Macoun & Kindberg, *Cat. Can. Pl.* 6 : 219.
1892.

EXSICCATI: *Hypnum radicale* Sullivant & Lesquereux, *Musc. Bor. Amer.*
(1st ed.) 346. (2d ed.) 524.

Hypnum orthocladon Sullivant & Lesquereux, *Musc. Bor. Amer.* (1st ed.)
347. (2d ed.) 526.

Amblystegium serpens var. *radicale* Austin, *Musc. App.* 376.

Amblystegium serpens var. *orthocladon* Austin, *Musc. App.* 379.

Hypnum varium Macoun, *Can. Musc.* 320.

Hypnum porphyrrhizum Macoun, *Can. Musc.* 319 (Herb. Wis.).

TYPE in Herb. Hedwig.

Gametophyte bisexual, of *medium size or larger*, forming extensive loose or closely crowded tufts, tufts sometimes as much as 3^{cm} deep, variable in color, bright green, dull dark green or pale yellowish green: stems 150 to 325 μ in diameter, 2 to 5^{cm} long, obscurely angled, prostrate, abundantly branched; central strand 8.5 to 35 μ in diameter, of six to twenty-five rows of cells; cortex of two to four layers of cells 6 to 18 μ in diameter; cells of ground tissue ranging from 17 to 30 μ ; branches stout or slender, 1 to 3^{cm} long, erect or ascending, flexuous, straight, or having the tips incurved, commonly crowded: leaves very variable in size and shape, lanceolate, *ovate lanceolate to broadly cordate ovate*, generally attaining greatest width in basal sixth, commonly gradually long acuminate, point usually slender, straight or slightly curved, margin entire or (in forms) denticulate above, flat or concave, costate, *costa extending to the apex or well into the base of the acumen*, one fifth to one fourth the leaf base at line of insertion; average leaves 500 μ wide by 1200 μ long, varying in width from 280 to 575 μ and in length from 800 to 1400 μ , both larger and smaller forms occurring, spreading or somewhat appressed in both moist and dry conditions; leaf cells parenchymatous at base, prosenchy-

matous above, commonly regular, occasionally irregular, usually the one or two basal rows of cells somewhat larger than those above, 10 to 18μ wide by 25 to 40μ long, alar cells above these short oblong, quadrate or occasionally slightly transversely elongated, 10 to 15μ wide by 8.5 to 17μ long, in the costal region usually short rectangular, in the middle and apical regions cells hexagonal or the marginal row frequently short rhomboidal, middle leaf cells 9.5μ wide by 35μ long, varying in width from 8 to 13μ and in length from 25 to 48μ , apical cells 10.3μ wide by 34μ long, ranging from 9 to 12μ wide and from 25 to 44μ long; outer perichaetial leaves triangular ovate, inner oblong, abruptly short acuminate, all strongly costate, costa excurrent, strict, or the outer spreading, serrulate or entire in the upper lamina.

Sporophyte small to large, 1 to 4^{cm} long: seta reddish at base, pale yellow above, or dark throughout, stout, 165 to 265μ in diameter; cortex of two to three layers of cells 6.4 to 14μ in diameter; central strand well differentiated, 20 to 36μ of eighteen to twenty-five rows of cells, cells of ground tissue 13 to 21.5 in diameter; capsule 1.5 to 6^{mm} long, cylindrical, asymmetric, upright to horizontal, almost straight to strongly arcuate, more or less contracted under the mouth when dry, pale yellowish green at maturity, becoming chestnut brown with age; cells of exothecium parenchymatous on the concave side, 32μ wide by 51.4μ long, varying in width from 15 to 47μ and in length from 30 to 90μ , prosenchymatous on the convex side, 27μ wide by 70μ long, ranging from 13 to 42μ wide and from 35 to 120μ long, cell walls 3 to 5μ thick, two to six rows of cells under the peristome hexagonal isodiametric or transversely elongated, 18 to 35μ in diameter; stomata fifteen to thirty to the capsule, scattered, 32μ wide by 43μ long; collum variable, one fourth to one half the length of the sporangium; teeth of peristome cinnamon brown or yellow, paler above, lanceolate, acuminate, serrulate, margined, margin broadest in the middle region, transversely striate on the back in the lower three fifths, sparsely papillose above; endostome pale, finely and densely papillose

throughout, membrane one half the length of the segments; the latter lanceolate, carinate, open along the keel between the articulations, rarely gaping; cilia two to four, slender, equaling the segments, nodose to imperfectly appendiculate; operculum obliquely apiculate from a high convex or conic base, usually as broad as the capsule; annulus of two to three rows of cells; spores light brown, minutely papillose, 13 to 21 μ in diameter; calyptra equaling the capsule or shorter, split half its length.

Hab.: On the ground, on decaying wood, at the bases of trees or occasionally on rocks, in moist or wet shady places. Type locality Lancaster, Pennsylvania.

Europe, North and tropical America: throughout southern Canada and the United States. Very common and widely distributed.

With the exception of *A. riparium*, the most variable of all species found in America; the smaller forms easily confused with *A. serpens*, while occasionally the more robust forms approach very nearly to *A. kochii* in the habit of growth and shape of leaf. Here as with *A. serpens*, while there is wide variation there are no forms of sufficient constancy to entitle them to varietal rank. The large form with erect straight branches commonly known as *A. orthocladon* perhaps is the most constant of all the forms, but I have not been able to call it anything more than a form.

AMBLYSTEGIUM IRRIGUUM (Wils.) Bruch & Schimp. *Plate XII.*
fig. 1.

SYNON.: *Hypnum fluviatile*. Many authors prior to 1854. Not of Swartz.

Hypnum irriguum Wilson, Bryolog. Brit. 361. *pl.* 25. 1855.—Berkeley, Handb. Brit. Moss. 97. 1863.—Hobkirk, Syn. 164. 1873.—Boulay, Musc. Fr. 72. 1884.—Lesquereux & James, Man. Moss. N. Amer. 374. 1884.

Amblystegium irriguum Bruch & Schimper, Bry. Eur. Ambly. 11 (under the name *A. fluviatile*, *pl.* 5. 1853.—Schimper, Syn. Musc. Eur. (1st ed.) 594. 1860. (2d ed.) 712. 1876.—Milde, Bry. Siles. 326. 1869.—De Notaris, Epil. Bry. Ital. 152. 1869.—Hartmann, Skand. Fl. (10th ed.) 20. 1871.—Lindberg, Musc. Scand. 32. 1879.—Hobkirk, Syn. (2nd ed.) 213. 1884.—Macoun and Kindberg, Cat. Can. Pl. 6:220. 1892.—Husnot, Musc. Gall. 360. *pl.* 103. 1894.—Dixon & Jameson, Stud. Handb. 444. *pl.* 56. 1896.—Braithwaite, Brit. Moss Fl. 3:21. *pl.* 88. 1896.

Amblystegium fluviatile var. *irriguum* R. du Buysson, Ess. Anal. gen. Ambly. 1883.

EXSICCATI: *Amblystegium serpens* var. *irriguum* Austin, Musc. App. 375.

TYPE in Herb. Wilson.

Gametophyte bisexual, of medium size or larger, closely caespitose, usually dark green, sometimes light green or yellowish or brown: stems rigid, prostrate or ascending, irregularly sub-pinnately branched, 2^{cm} to 6^{cm} long, 200 to 350 μ in diameter, cylindrical; central strand well differentiated, 25 to 40 μ in diameter of sixteen to twenty-five rows of cells; cortex of three or four layers of cells, 6.5 to 13 μ in diameter, walls strongly thickened, cells of ground tissue abruptly enlarged just within the cortex and increasing uniformly toward the center of the stem, reaching the greatest size near the central strand, 18 to 38.5 μ in diameter; branches in the looser forms creeping or ascending, erect or ascending in the compactly growing patches, 0.5 to 3^{cm} long: leaves deltoid ovate, or ovate lanceolate, 400 μ wide by 1000 μ long, in large forms reaching 1500 μ long, more or less cordate and decurrent, reaching greatest width in basal fifth, occasionally just above the line of insertion, acuminate, subserulate, open-erect or spreading, frequently subfalcate and subsecund, costate to near the apex of the usually long and slender acumen, costa strong, thick, one-fifth to one-third the entire leaf base at line of insertion, 60 to 85 μ wide, tapering uniformly to the tip of the leaf, biconvex, in the dry condition leaf points slightly incurved, otherwise as in the moist condition; leaf cells parenchymatous at base, prosenchymatous above, usually one row of cells across the base of the leaf much enlarged, 13 to 21.5 μ wide by 30 to 55 μ long, cells immediately above these short-oblong, 13 μ wide by 21.5 μ long, narrowing rapidly and becoming prosenchymatous at the greatest width of leaf, the cells in the alar regions (excluding the row of large cells at base) slightly transversely elongated, quadrate or short oblong, soon becoming oblong or rhomboidal above, 12 to 16 μ wide by 9 to 20 μ long, cells in the middle and upper parts of the leaf rhomboidal or hexagonal, the former 8.6 μ wide by 31.5 μ long, occasionally somewhat narrower, 6 μ wide by 40 μ long, the latter 9.5 μ wide by 43 μ long; perichæatial

leaves ovate lanceolate to oblong lanceolate, erect, acuminate, costate, costa excurrent.

Sporophyte usually large, 1.5 to 4^{cm} long: seta stout, 200 to 280 μ in diameter, dark purple below, reddish above; central strand equaling in diameter the largest cells of the ground tissue, 30 μ , composed of ten to eighteen rows of cells; cortex of two to three layers of cells 8.6 to 12.8 μ in diameter; cells of ground tissue varying from 18.5 to 30 μ in diameter, the largest found about midway between the cortex and the central strand: capsule oblong or cylindrical, asymmetric, rarely almost symmetric, slightly inclined to strongly incurved, suberect to horizontal, generally strongly constricted under the mouth when dry; collum one-third the length of the sporangium; cells of exothecium mostly parenchymatous, more or less prosenchymatous on the convex side, cells on the convex side varying from 15 to 55 μ wide and from 55 to 165 μ long, averaging 30 μ wide by 120 μ long, cells of concave side 22 to 60 μ in width and 43 to 128 μ in length, averaging 38 μ wide by 76 μ long, walls 2 to 4 μ thick, five to seven rows of cells under the mouth of the capsule isodiametric, or the three next the annulus slightly transversely elongated, 20 to 40 μ in diameter; stomata thirty to forty to the capsule, 44 μ wide by 58 μ long, scattered; peristome teeth lanceolate, orange below, hyaline above, bordered, border narrow at base, becoming broader above, teeth entire or slightly serrulate above, transversely striate in the lower half or two thirds, papillose above; endostome shorter than the teeth, hyaline, papillose throughout, membrane three-fourths the length of the segments, the latter lanceolate to ovate-lanceolate, carinate, open along the keel between the articulations, not gaping, cilia two to four, equaling the segments or shorter, nodose; operculum apiculate from a highly convex or conic base; annulus broad, of two to three rows of cells: spores yellowish green, coarsely tuberculate, 15 to 21 μ in diameter: calyptra two-thirds the length of the capsule, split half its length.

HAB.: Along the margins of brooks, ponds, lakes and other similar places on the ground and on stones. Type locality England.

Europe, Asia, Africa, and North America: New England, New York, New Jersey, Ohio, West Virginia, Wisconsin, Montana, Minnesota and Ontario. Not uncommon.

Long confused with *A. fluviatile*, from which plant it may be known by its long acuminate leaves, with a costa tapering gradually and uniformly from the base to the tip of the leaf, and by the leaf cells, which, above the basal row, are commonly uniformly smaller. This is especially true for the basal third of the leaf. The general habit of the two plants will aid in separating them, *A. irriguum* having a harsh and rigid appearance, while *A. fluviatile* is soft and pliable. *A. irriguum* may be distinguished from *Hypnum filicinum* by the broad triangular ovate leaves of the latter, having a distinctly serrate margin in the upper part and having the cells in the alar regions inflated.

AMBLYSTEGIUM IRRIGUUM SPINIFOLIUM Schimp. *Plate XII.*
fig. 1.

SYNON.:¹ *Hypnum fallax* Bridel, *Musc. Recent.* 3²: 66. *pl. 2. f. 1.* 1801.
(fide Schimper, and many later authors.)

Hypnum filicinum var. *fallax* Hooker & Taylor, *Muscologia Brittanica*, 109.—Bridel, *Bry. Univ.* 2: 531. 1827.

Hypnum fluviatile C. Mueller, *Syn. Musc. Frond.* 2: 420. 1851.

Amblystegium irriguum var. *fallax* Schimper, *Syn. Musc. Eur.* (1st ed.) 594. 1860.

Amblystegium irriguum var. *spinifolium* Schimper, *Syn. Musc. Eur.* (2d ed.) 713. 1876.

Amblystegium fallax Lindberg, *Musc. Scand.* 32. 1879.—Braithwaite, *Brit. Moss. Fl.* 3: 19. *pl. 88.* 1896.

Amblystegium filicinum var. *fallax* Lindberg, *Musc. Scand.* 35. 1879.

Amblystegium fluviatile var. *irriguum*, forma *spinifolium* R. du Buysson, *Ess. Anal. gen. Ambly.* 1883.

Amblystegium vallis-clausæ var. *spinifolium* Husnot, *Musc. Gall.* 361. 1894.

TYPE in Herb. Bridel.

Gametophyte more robust than in the species; stems longer, 3 to 12^{cm}, more loosely branching; leaves generally longer and narrower, with a long excurrent slender-pointed costa, 900 to 1800 μ long by 200 to 585 μ wide; leaf cells at least in the upper portions of the leaf correspondingly elongated, 6 to 9 μ wide by 40 to 70 μ long.

¹ No attempt has been made to give a complete synonymy, owing to the confusion prior to the time of Schimper.

Sporophyte as in the species.

HAB.: In very wet places, either floating or on substratum kept constantly wet by spray or falling water. It appears to be of common occurrence in Europe, but is seldom met with in N. America. Type locality Europe.

Europe, Asia, Africa, and North America: New Jersey and Pennsylvania.

This form has been confused with the submerged form of *A. noterophilum* by most bryologists who have worked with American mosses. The latter is usually a much larger plant, having the body of the leaf ovate or broader, generally not acuminate except by the very strong long excurrent costa, which is twice as wide as that found in *A. irriguum spinifolium*; often appearing much wider, owing to the presence of a second layer of cells in the costal region of the lamina.

AMBLYSTEGIUM NOTEROPHILUM (Sulliv.) Holzinger. *Plate XII. fig. 3.*

SYNON.: *Hypnum noterophilum* Sullivant, *Musc. and Hepat. of U. S.* 78. 1856.

Hypnum fluviatile James, *Proc. Academy Nat. Sciences of Philadelphia* 1855: 447. 1855.

Hypnum irriguum var. *spinifolium* Lesquereux & James, *Man. Moss. N. Amer.* 374. 1884.—Macoun & Kindberg, *Cat. Can. Pl.* 6: 220. 1892.

Amblystegium noterophilum Holzinger, *Bull. Geol. and Nat. Hist. Surv. Minn.* 9: 293. Nov. 1895.

EXSICCATI: *Hypnum noterophilum* Sulliv. & Lesq., *Musc. Bot. Amer.* (1st ed.) 348.

Amblystegium serpens irriguum noterophilum Austin, *Musc. App.* 385.

TYPE in Herb. Sullivant, Cambridge.

Gametophyte bisexual, of medium or large size, varying from bright yellow green to a very dark dull green, rarely bronze in the new shoots of submerged plants, sometimes having a vitreous appearance, *harsh and rigid*, when growing out of water in close moderately thick tufts, in the water forming crowded floating masses: *stems rigid*, prostrate or ascending when not submerged, otherwise floating, profusely and irregularly branched, 2 to 15^{cm} long, 200 to 400 μ in diameter, cylindrical; cortex of three to

four layers of incrassate cells 4 to $17\ \mu$ in diameter; central strand well differentiated, 30 to $45\ \mu$ in diameter, of twelve to twenty-one rows of cells; branches in terrestrial form ascending, 1 to 2.5^{cm} long, those of the submerged form 3 to 8^{cm} long bearing few short (1^{cm}) branchlets, in all cases densely leafy, the stems and branches of the submerged plants *at length naked or covered with the very stout excurrent costæ of the leaves*, due to the maceration of the leaf blade: leaves varying from *broadly triangular cordate ovate* in land form to long lanceolate in submerged form, *generally abruptly short acuminate by the excurrent costa*, straight or with the point moderately curved, in water form $550\ \mu$ wide by $1350\ \mu$ long, varying from 450 to $700\ \mu$ wide and from 1050 to $1500\ \mu$ long, extremely large plants having leaves $900\ \mu$ wide by $2200\ \mu$ long, in terrestrial plants the leaves proportionately wider, $500\ \mu$ wide by $850\ \mu$ long, rarely reaching $450\ \mu$ wide by $600\ \mu$ long, *strongly costate, costa commonly excurrent forming a very thick rather blunt cusp*, sometimes in the land form vanishing in the tip, one-sixth to one-third the leaf base at line of insertion, 65 to $225\ \mu$ wide, plano-convex at base, double convex above to the tip, there sometimes becoming again flattened on the upper side; leaf blade *very commonly of two layers of cells in the basal sixth and along the costa well toward the tip*, margin usually entire, rarely slightly serrulate in the upper part of blade, greatest width of leaf attained in the basal sixth, open or erect spreading in land plants, slightly spreading or strict in submerged form; leaf cells parenchymatous at base, prosenchymatous in the middle and upper lamina, or mixed at the upper end of the blade, in the alar and apical regions in the extreme long and short forms cells essentially the same in size, those in the middle portion of the long leaves proportionately longer, in average leaves alar cells $14\ \mu$ wide by $22\ \mu$ long, varying from 12 to $17\ \mu$ wide and from 19 to $23\ \mu$ long, the middle leaf cells varying from 9 to $11\ \mu$ wide and from 38 to $45\ \mu$ long, averaging $10.5\ \mu$ wide by $43.4\ \mu$ long, these cells varying in the extreme forms from 9 by $18\ \mu$ to 12 by $90\ \mu$, cells in upper lamina beside the costa $10\ \mu$ wide by $28\ \mu$ long, ranging from 9 to $11\ \mu$ in width and from

25 to 32 μ long; perichæatial leaves not essentially different from the others in shape and size, strongly costate, costa excurrent, cells *incrassate*, leaves all strict.

Sporophyte of medium size, 1.5 to 2.5^{cm} long, produced only on plants not submerged: seta stout, purple at base, paler almost yellow in upper third, 270 to 330 μ in diameter; cortex of three (occasionally four) layers of cells, these 6 to 15 μ in diameter; central strand 35 to 50 μ in diameter, composed of twenty to fifty rows of cells; cells of ground tissue 18 to 35 μ in diameter; capsule purple or dark chestnut brown, large, 2 to 4.5^{mm} long, cylindric or widening gradually from the base of the collum to the lid, asymmetric, incurved from an erect base, gradually cernuous, much shrunken in all parts and constricted under the mouth in drying; collum large, one-half to two-thirds the length of the sporangium; cells of the exothecium parenchymatous for the most part throughout, sometimes more or less prosenchymatous on the convex side, cells on the concave side 24 μ wide by 33 μ long, varying in width from 17 to 35 μ and in length from 21 to 50 μ , cells of convex side 18 μ wide by 55 μ long, ranging from 15 to 30 μ wide and from 25.5 to 77 μ long; cell walls 3 to 6 μ thick; cells under the peristome slightly smaller, two to four rows 8.5 to 30 μ long by 17 to 38.5 μ wide; stomata *very numerous, ninety to two hundred* to the capsule, *crowded in a comparatively narrow band and often clustered, two to seven adjoining, commonly as broad as long or broader, average 37.5 μ wide by 36 μ long*; teeth of peristome yellow at base yellowish brown above to the slender hyaline tip, lanceolate, acuminate, irregularly serrulate in upper third, narrowly bordered, transversely striate on the back to the middle or beyond, coarsely and irregularly papillose in upper third; endostome pale and faintly papillose throughout, shorter than the teeth, membrane two-thirds to three-fourths the length of the segments, the latter lanceolate, carinate, open along the keel between the articulations or with only occasional perforations along the keel, cilia one to three, slender, weak, nodose, shorter than the segments; operculum apiculate from a highly convex base: spores finely

papillose, 16 to 30 μ in diameter: calyptra one-half to three-fourths the length of the capsule, split one-third its length, falling before the spores are mature.

HAB.: In springs and at their margins (usually calcareous), and the streams running from them. Type locality Franklin county, Pennsylvania.

North America: Pennsylvania, New York, Illinois, Michigan, Wisconsin, Minnesota, Montana, Ontario. Local.

A plant that appears to be related to both *A. irriguum* and *A. fluviatile* with both of which it has been associated, especially the large floating form. Doubtless the absence of the sporophyte from most material and the exclusive (?) use of the water form for study have led to this confusion.

AMBLYSTEGIUM FLUVIATILE (Swartz) Br. & Sch. *Plate XII. fig. 2.*

SYNON.: *Hypnum fluviatile* Swartz, *Musc. Frond. Suec.* 63. 1799.—Hedwig, *Spec. Musc.* 277. *pl. 71. fig. 4.* 1801.—Palisot de Beauvois, *Prodr.* 1805.—Weber & Mohr, *Bot. Tasch.* 303. 1807.—Schwægrichen, *Spec. Musc. Suppl.* 1. 2 : 263. 1816.—Hartmann, *Skand. Fl.* (5th ed.) 333. 1849.—Wilson, *Bry. Brit.* 359. *pl. 55.* 1855.—Berkeley, *Handb. Brit. Moss.* 98. 1863.—Hobkirk, *Syn.* 164. 1873.—Lesquereux & James, *Man. Moss. of N. Amer.* 375. 1884.

Hypnum orthocladon Palisot de Beauvois, *Prodr.* 67. 1805.

Hypnum palustre fluviatile Wahtenberg, *Fl. Suec.* (2d ed.) 732. 1833.

Amblystegium fluviatile Bruch & Schimper, *Bry. Eur. Ambly. Suppl.* 1. 1. *pl. 1.* 1854.—Schimper, *Syn. Musc. Eur.* (1st ed.) 594. 1860. (2d ed.) 713. 1876.—Milde, *Bry. Siles.* 326. 1869.—Hartmann, *Skand. Fl.* (10th ed.) 20. 1871.—Lindberg, *Musc. Skand.* 32. 1879.—R. duBuysson, *Ess. Anal. gen. Ambly.* 12. 1883.—Hobkirk, *Syn.* (2d ed.) 213. 1884.—Macoun & Kindberg, *Cat. Can. Pl.* 6 : 220. 1892.—Husnot, *Musc. Gall.* 360. 1894.—Dixon & Jameson, *Stud. Handb.* 445. *pl. 56.* 1896.—Braithwaite, *Brit. Moss Fl.* 3 : 22. *pl. 88.* 1896.

Hypnum irriguum fluviatile Boulay, *Musc. Fr.* 73. 1884.

EXSICCATI: *Amblystegium fluviatile* Austin, *Musc. App.* 38.—Macoun, *Can. Musc.* 446.

TYPE in herb. Swartz, Stockholm.

Gametophyte bisexual, *soft and pliant*, of medium or large size, when not submerged on a solid substratum in dense thick tufts, when submerged, having a looser habit, sometimes considerably elongated and floating, varying in color from a dark dirty green to

light yellowish green, *usually with a vitreous or metallic luster*: stems prostrate when not submerged, ascending or floating when in the water, abundantly branched, sometimes sparingly so in water, *defoliate in the older portions* by the maceration of the leaves, 3 to 8^{cm} long, 180 to 210 μ in diameter, scarcely angled; *central strand rudimentary or none*, when present of three to six rows of cells; cortex of two to four layers of cells 8.6 to 13 μ in diameter, cells of ground tissue 13 to 20 μ in diameter, abruptly larger than the cells of the cortex; branches simple, inclined or suberect, 1.5 to 4^{cm} long in terrestrial forms, longer in submerged plants, 3 to 7^{cm}, often with tips slightly hooked: leaves ovate, ovate lanceolate or oblong lanceolate, average leaves 650 to 700 μ wide and 1500 to 1600 μ long, concave, *very slightly or not at all acuminate*, point *usually blunt, entire*, strongly costate, costa plano-convex in the basal fourth of the leaf, double convex to almost cylindrical above, one-sixth to one-fourth the leaf base at the line of insertion, 85 to 120 μ in width, tapering somewhat to the tip of the leaf, *here 45 to 60 μ in width, flattening and disappearing abruptly within the point*, strictly erect or slightly spreading, occasionally subsecund, slightly incurved when dry, especially in terrestrial forms, not decurrent; leaf cells parenchymatous in lower half, at base *large*, 13 to 21.5 μ wide by 30 to 70 μ long, averaging across the base 16 μ wide by 40 μ long; passing gradually into cells above varying from linear rectangular to linear rhomboidal or shorter, 10.5 μ wide by 3 to 7 μ long; these again passing gradually into cells regularly hexagonal, 10.5 μ wide by 38 μ long, cells at apex 15 μ wide by 30 μ long, alar cells rarely noticeably differentiated; perichæcial leaves ovate or ovate-lanceolate, acute or sometimes short acuminate, costate to the erect apex, cells linear or nearly so, entire or denticulate at apex.

Sporophyte medium to large, 1.5 to 3.5^{cm} long: seta 180 to 240 μ in diameter, purple at base, gradually passing to light brown or yellow above; central strand well developed, 25 to 45 μ in diameter, of sixteen to thirty-five rows of cells; cortex of two to three layers of cells 6 to 12 μ in diameter; cells of ground tissue abruptly larger than cortical cells, 13 to 20 μ , larg-

est cells midway between cortex and central strand: capsule pale at maturity before dehiscence, usually brick red to chestnut brown when empty, 2 to 5^{mm} long, subcylindric or gradually widening to the mouth, incurved from an erect base to arcuate, more or less constricted below the mouth when dry; collum one-third to one-half the length of the sporangium; cells of exothecium parenchymatous on the concave side, 25 μ wide by 47 μ long, varying in width from 17 to 43 μ , and in length from 21 to 77 μ , longer on the convex side and more or less prosenchymatous, especially in the lower half of the sporangium, 25.5 μ wide by 53.5 μ long, ranging from 15 to 35 μ wide and from 25 to 120 μ long, five to seven rows of cells under the mouth isodiametric, 17 to 25.5 μ in diameter, usually about two rows next the annulus transversely elongated, 8.5 to 15 μ long by 17 to 30 μ wide; cell walls 3 to 4 μ thick; stomata numerous, *twenty-five to eighty* to the capsule, 38.5 μ wide by 47 μ long, scattered; peristome teeth orange or reddish-brown below, margined, margin narrow at base widening above into the hyaline tip, serrulate in upper third, transversely striate on the back in the lower half, papillose above, occasionally having the striæ oblique or irregular in small areas near the middle; endostome pale, scarcely equaling the teeth, papillose throughout, membrane three-fourths the length of the segments, the latter lanceolate, carinate, split along the keel between the articulations, not gaping, cilia two or three, shorter than the segments, nodulose or subappendiculate; operculum conic and acute or apiculate from a highly convex base; annulus broad, of two to three rows of cells: spores finely tuberculate, 16 to 26 μ ; calyptra small, one-fourth to one-half the length of the capsule, split one-third its length.

HAB.: On rocks and earth in and along streams. Type locality Sweden.

Europe, and North America: New Brunswick, Newfoundland, Quebec, Ontario, New York, New Jersey, Ohio, Michigan, and Wisconsin.

The leaves of this species, usually not acuminate, with entire margin, broad blunt apex and strong costa vanishing in the tip, are generally suf-

ficient to enable one to distinguish it from its near relatives *A. irriguum* and *A. noterophilum*. Its larger leaf cells in the basal half will assist in separating it from the first, while the second generally has a much wider and generally excurrent costa, and two layers of cells in the lamina at the base and along the costa for half its length or more.

AMBLYSTEGIUM LESCURI (Sulliv.) Aust. *Plate XI. fig. 9.*

SYNON.: *Hypnum lescurii* Sullivant, *Musc. and Hepat. of U. S.* 79. 1856. *Icon. Musc.* 203. *pl. 124.* 1864.—Lesquereux & James, *Man. Moss. of N. Amer.* 376. 1884.

EXSICCATI: *Hypnum lescurii* Sulliv. & Lesq., *Musc. Bor. Amer.* (1st ed.) 350 (2d ed.) 529.

Amblystegium lescurii Austin, *Musc. App.* 371. 1870.

TYPE in herb. Sullivant, Harvard University.

Gametophyte bisexual, of medium size, loosely cespitose, yellowish to dark green, ferruginous within the tufts with age: stems prostrate, generally defoliate in older parts, profusely branched, thick, rigid, 160 to 210 μ in diameter, 2 to 6^{cm} long, obscurely angled; central strand small, 6 to 10 μ in diameter, composed of five to ten rows of cells; cortex of three to five layers of small incrassate cells, 6.5 to 13 μ in diameter, well differentiated from ground tissue, the cells of the latter abruptly larger, 18 to 26 μ in diameter; branches erect with very few branchlets, 1 to 3^{cm} long: leaves ovate to very broadly ovate, occasionally as broad as long, 360 μ wide by 750 μ long, reaching in some instances 1500 μ long, concave, abruptly short acuminate, bordered, border of two layers of linear vermicular incrassate cells, three to five cells wide, denticulate at apex, sometimes sparingly so to near the base, costate, costa thick, bi-convex in section, 40 to 55 μ wide, extending to the apex of the leaf, here becoming flattened and blending with the thickened border, when moist spreading in all directions, rarely subsecund, in the dry state the leaf tips more or less inflexed from the open-spreading bases; leaf cells parenchymatous, walls thick in all parts of the leaf, in the alar region usually a few short oval cells, excluding these alar cells long hexagonal or rhomboidal, 9 μ wide by 25 μ long, ranging in width from 6.5 to 13 μ and in length from 15 to 32 μ , in the middle border region cells 5.6 μ wide by 30.8 μ long, vary-

ing from 4.5 to 8.5μ in width and from 24 to 39μ in length, in the middle costal region cells much shorter and oval-hexagonal, 7.5μ wide by 18μ long, midway between border and costa the cells still shorter, at the apex the marginal cells oval or subrhomboidal, 9μ wide by 17μ long, varying from 8 to 10μ wide and from 14 to 20μ long; perichæcial leaves ovate lanceolate to lanceolate, the outer gradually acuminate, all erect, strongly costate, costa long excurrent.

Sporophyte medium, 1 to 3^{cm} long: seta stout, 250 to 300μ in diameter, dark purple below, yellow above; central strand well developed, 30 to 38μ in diameter, of thirty to forty rows of cells, walls of cells strongly thickened for this tissue; cortex of three to four layers of cells, 4 to 13μ , passing gradually into ground tissue; cells of this tissue ranging from 13 to 23μ : capsule oblong, unsymmetric, cernuous, with short collum, becoming dark brick red with age, not constricted under the mouth when dry or only moderately so; cells of exothecium parenchymatous on concave side, 23μ wide by 32μ long, ranging in width from 20 to 26μ , and in length from 17 to 47μ , prosenchymatous on convex side, 20μ wide by 40μ long, varying from 13 to 23μ wide and from 30 to 65μ long; cell walls 2 to 3μ thick; three to five rows of isodiametric, quadrate or hexagonal cells under the mouth, 15 to 22μ in diameter, walls 4μ thick; stomata ten to twenty-five to the capsule, 30.5μ wide by 34.5μ long, scattered; peristome teeth lanceolate, golden yellow with a broad paler margin, serrate in the upper half, transversely striate on the back to near the middle, above this point dotted with scattered papillæ among the striæ, the latter soon being replaced above by densely crowded ciliate papillæ; endostome pale yellow, equaling the teeth; membrane two-thirds the length of the segments, the latter lanceolate, carinate, split, but not widely open along the keel between the articulations, finely papillose, cilia one to three, stout, shorter than the segments, nodulose; operculum apiculate from a convex or conic base; annulus broad, of two to three rows of cells: calyptra equaling capsule, split one-third its length.

HAB.: On wet rocks, usually in mountain streams. Type locality Tallulah Falls, Georgia.

North America: Georgia, Virginia, West Virginia, Pennsylvania, New York, New Jersey, Maine. Rare or local.

The most distinctly characterized of all our *Amblystegia*. No difficulty need be experienced in separating it from other species if one of its leaves is at hand. The leaf border is evident under moderate magnification.

AMBLYSTEGIUM RIPARIUM (Hedw.) Br. & Sch. *Plate XIII. fig. 1.*

SYNON.: *Hypnum riparium* Hedwig, *Musc. Frond.* 4:7 *pl.* 3. 1797. *Spec. Musc.* 241. 1801.—Abbot, *Flora Bedfordiensis* 250. 1798.—Hull, *British Flora* 2:273. 1799.—Swartz, *Musc. Suec.* 1799.—Bridel, *Musc. Recent.* 3:176. 1801. *Spec. Musc.* 2:112. 1812. *Mant. Musc.* 157. 1819. *Bry. Univ.* 2:412. 1827.—Smith, *Fl. Brit.* 1292. 1804. *Eng. Bot. pl.* 2060.—Turner *Musc. Hib.* 152. 1804.—Palisot de Beauvois, *Prodr.* 69. 1805.—Schultz, *Fl. Starg.* 324. 1806.—Weber & Mohr, *Bot. Taschen.* 331. 1807.—Voit, *Muscorum Herbipolitano* 111. 1812.—Schwægrichen, *Spec. Musc. Suppl.* 1. 2:194. 1816.—Hooker & Taylor, *Musc. Brit.* 92. 1818.—Hooker *Fl. Scot.* 2:141. 1820.—Funck, *Moost.* 56. *pl.* 37. 1821.—Gray, *Nat. Arr. Brit. Pl.* 1:752. 1821.—Huebener, *Musc. Germ.* 619. 1833.—DeNotaris, *Syllab.* 4. 1838.—Rabenhorst, *Deutschl. Kr. Fl.* 2³:293. 1848.—C. Mueller, *Syn. Musc. Frond.* 2:321. 1851. *Deutschl. Moos.* 427. 1853.—Wilson *Bry. Brit.* 364. 1855.—Sullivant, *Musc. and Hepat. U. S.* 79. 1856.—Berkeley, *Handb. Brit. Moss.* 98. 1863.—Hobkirk, *Syn.* 164. 1873.—Boulay, *Musc. Fr.* 76. 1884.—Lesquereux & James, *Man. Moss. N. Amer.* 376. 1884.—Dixon & Jameson, *Stud. Handb.* 452. 1896.

Amblystegium riparium Bruch & Schimper, *Bry. Eur. Ambly.* 14. *pl.* 8. 1853.—Schimper, *Syn. Musc. Eur.* (1st ed.) 597. 1860. (2d ed.) 717. 1876.—Milde, *Bry. Siles.* 328. 1869.—De Notaris, *Epil. Bry. Ital.* 146. 1869.—Hartmann, *Skand. Fl.* (10th ed.) 19. 1871.—R. du Buysson, *Ess. anal. gen. Ambly.* 1883.—Hobkirk, *Syn.* (2d ed.) 213. 1884.—Macoun & Kindberg, *Cat. Can. Pl.* 6:221. 1892.—Husnot, *Musc. Gall.* 363. *pl.* 104. 1893.—Braithwaite, *Brit. Moss. Fl.* 3:29. *pl.* 89. 1896.

Stereodon riparium Mitten, *Jour. Linn Soc.* 8:43. 1864.

EXSICCATI: *Hypnum riparium* Sulliv. & Lesq., *Musc. Bor. Amer.* (1st ed.) 349. (2d ed.) 527.—Macoun, *Can. Musc.* 325.

TYPE probably not in existence. The plant was known to botanical writers prior to the time of Dillenius, probably early in the eighteenth century.

Gametophyte bisexual, medium to very large, in extensive loose tufts, bright green to yellowish green, occasionally of a decided yellow or bronze: stems long, flaccid, prostrate or floating, spar-

ingly branched, 5 to 20^{cm} long, 250 to 400 μ in diameter, cylindrical; central strand well differentiated though small, 20 to 27 μ in diameter, of ten to fifteen rows of cells; cortex of two to three layers of cells, usually not well differentiated, cells 8 to 22 μ in diameter, those of the ground tissue 17 to 40 μ ; primary branches few, 2 to 8^{cm} long, prostrate, branchlets short, 1 to 3^{cm}, prostrate: leaves ovate lanceolate to linear lanceolate, long acuminate, terminating in a slender, straight, or curved point, 650 μ wide by 2200 μ long, ranging in width from 450 to 700 μ and in length from 1700 to 2400 μ , attaining greatest width in the basal fifth, many ranked, commonly complanate, occasionally equally spreading or subsecund, rarely erect, ordinarily more or less widely spreading, frequently folded or twisted when dry, costate, costa thin, extending through the lower half to three-fourths of the leaf, one-sixth to one-fifth its base at the line of insertion, 50 to 75 μ wide, margin ordinarily *very entire*, rarely subserrulate; leaf cells parenchymatous across the base, soon becoming prosenchymatous above, the basal cells quadrate to oblong, the one or two marginal rows narrower and longer, 16 μ wide by 36.6 μ long, ranging from 13 to 20 μ in width and from 20 to 50 μ in length; cell walls strongly thickened and *sparsely* pitted, in all parts of the leaf above the basal eighth the cells *long hexagonal to linear*, in the middle region 8.5 μ wide by 95 μ long, varying in width from 7.8 to 9 μ and in length from 85 to 100 μ , frequently vermicular, cells of apical region shorter, 9.3 μ wide by 34 μ long, ranging from 8.8 to 10 μ in width and from 28 to 38 μ in length; outer perichæatial leaves triangular-ovate, spreading from the middle, inner oblong, erect, all abruptly short acuminate and costate to the base of the acumen or nearly so, coarsely and irregularly serrate above or entire.

Sporophyte medium, 1 to 3^{cm} long: seta purple at base, light brown or yellow above, or uniformly pale brown throughout, 170 to 260 μ in diameter, cortex of two to three layers of cells, 6.5 to 15 μ in diameter; central strand well differentiated, 30 to 36.5 μ in diameter, composed of thirty to forty-five rows of cells; cells of ground tissue 9 to 26 μ in diameter: capsule short, oval,

1 to 2^{mm} long, pale yellowish green at maturity, sometimes of two colors, pale on the concave side and brown above, becoming a uniform light brown or dark chestnut brown, unsymmetric, from slightly inclined to horizontal, strongly incurved, constricted under the mouth when dry; collum one-fourth to one-third the length of the sporangium; cells of exothecium parenchymatous throughout or more or less prosenchymatous on the convex side, cells on the concave side 43μ wide by 53.5μ long, ranging from 21.5 to 60μ in width and from 30 to 77μ in length, those on the convex side 34.5μ wide by 82.5μ long, ranging in width from 21 to 43μ and in length from 60 to 120μ , cells under the peristome but slightly different, sometimes one or two rows a little smaller and transversely elongated, 17 to 21.5μ long by 17 to 26μ wide; cell walls 2 to 3μ thick; stomata twenty-five to thirty-five to the capsule, scattered, 43μ wide by 52μ long; peristome teeth light brown at base, paler above, hyaline at the points, narrowly margined, serrate in the upper third, transversely striate on the back in the basal three-fifths, with occasional areas near the middle with striæ running obliquely or longitudinally, papillose above, papillæ large; endostome shorter than the teeth, hyaline, papillose throughout, membrane one-half to two-thirds the length of the segments, the latter carinate, frequently not open along the keel except in the upper third, never gaping, cilia one to four, slender, nodose or appendiculate, equaling the segments; operculum rostellate or apiculate from a depressed convex to conic base; annulus broad, of two to three rows of cells: spores finely tuberculate, 13 to 21μ in diameter: calyptra equalling the capsule, split half its length or less.

HAB.: In wet localities, either in stagnant or slow running water, or on the ground, logs, boards, etc.

Type locality England, Thames river. Common and variable everywhere.

This species is probably the most variable of all our *Amblystegia* though in general habit it is comparatively constant. It is sometimes confused with *Hypnum* (*Campylium*) *polygamum*. The latter plant generally has a different habit; its stems more or less upright, with leaves equally spreading in all directions from near the base.

AMBLYSTEGIUM RIPARIUM FLORIDANUM Ren. & Card. *Plate XIII. fig. 2.*

SYNON.: *Amblystegium riparium* var. *floridanum* Renauld & Cardot, Botanical Gazette 14:98. 1889.

Amblystegium floridanum Renauld & Cardot, Musci. Americæ Septentrionalis 58. 1893.

TYPE in herb. Cardot, Stenay, France.

Gametophyte small: stems 1 to 2^{cm} long, sparsely branched: leaves *linear to lanceolate*, 50 to 330 μ wide by 800 to 1200 μ long; leaf cells about as in the species in all parts.

Sporophyte small, 1^{cm} long; capsule 1 to 1.5^{mm} long.

Hab.: On decaying wood in moist or wet places. Type locality Florida and Louisiana.

North America: Gulf and south Atlantic states.

Has the general habit and appearance of the species throughout. May be known by its very small size.

AMBLYSTEGIUM RIPARIUM ABBREVIATUM Br. & Sch.

SYNON.: *Amblystegium riparium abbreviatum* Bruch & Schimper, Bry. Eur. Ambly. 14. *pl. 9. f. β . 1 and 2.* 1853.—Schimper, Syn. Musc. Eur. (1st ed.) 598. 1860 (2d ed.) 718. 1876.—De Notaris, Epil. Bry. Ital. 147. 1869.—Husnot, Musc. Gall. 363. 1894.—Braithwaite, Brit. Moss. Fl. 3:30. 1896.

Hypnum riparium var. *abbreviatum* Lesquereux & James, Man. Moss. N. Amer. 377.

Gametophyte with stems and branches *short*, the former 1 to 3^{cm} long, the latter 1^{cm} long: leaves as in the species except a little smaller in size.

Sporophyte as in medium forms of the species.

Type locality, Europe.—Europe and North America.

Probably this and the preceding variety will have to be omitted when more abundant material can be obtained for study. Found occasionally with the species.

AMBLYSTEGIUM RIPARIUM FLACCIDUM (L. & J.) R. & C.

SYNON.: *Hypnum riparium* var. *flaccidum* Lesquereux & James Man. Moss. N. Amer. 377.

Amblystegium riparium var. *flaccidum* Renauld & Cardot, Musc. Amer. Sept. 58. 1893.

TYPE in herb. James, Harvard University.

Gametophyte very much attenuated: stems long, filiform, 10 to 40^{cm} long, sparingly branched; branches correspondingly long: leaves slender, remote.

Sporophyte usually much larger than in other forms, 3 to 6^{cm} or more long, not abundant.

HAB.: Growing in the water, generally in shaded places. A common form in N. America with the species.

AMBLYSTEGUM RIPARIUM FLUITANS (L. & J.) R. & C.

SYNON.: *Hypnum riparium* var. *fluitans* Lesquereux & James, Man. Moss. N. Amer. 377.

Amblystegium riparium var. *fluitans* Renauld & Cardot, Musc. Amer. Sept. 58. 1893.

Gametophyte large: stems and branches long, 10 to 20^{cm}, dirty green or yellow: leaves large, 800 μ wide by 3200 μ long, sometimes more than 4000 μ in length and of proportionate width.

Sporophyte rarely produced, not seen by me.

HAB.: Floating in shallow water at margins of streams and from logs, stumps, etc., in the water.

With the species. Not uncommon.

AMBLYSTEGIUM RIPARIUM LONGIFOLIUM (Schultz) Sch. & Buys.

SYNON.: *Hypnum longifolium* Schultz, Fl. Starg. 335. 1806.—Bridel, Spec. Musc. 2: 114. 1812. Mant. Musc. 158. 1819.

Hypnum riparium longifolium Bridel, Bry. Univ. 2: 414. 1827.

Amblystegium riparium var. *longifolium* Schimper, Syn. Musc. (1st ed.) 598. 1860. (2d ed.) 718. 1876.—Braithwaite, Brit. Moss. Fl. 3: 29.

Gametophyte large, yellowish green to bright yellow or bronze: stems moderately elongated, 3 to 8^{cm} long: leaves large, 600 to 700 μ wide by 3500 to 4200 μ long, acuminate, acumen very slender.

Sporophyte unknown to me.

HAB.: Europe, and North America: Vancouver and Washington.

The forms here given as varieties are thought to be the most constant ones and those about which the well nigh numberless others may be satisfactorily grouped.

AMBLYSTEGIUM KOCHII Br. & Sch. *Plate XII. fig. 5.*

SYNON.: *Amblystegium kochii* Bruch & Schimper, Bry. Eur. Ambly. 13. *pl. 6.* 1853.—Schimper, Syn. Musc. Eur. (1st ed.) 596. 1860. (2d ed.) 716. 1876.—Milde, Bry. Siles. 327. 1869.—Hartmann, Skand. Fl. (10th ed.) 19. 1871.—Husnot, Musc. Gall. 362, *pl. 104.* 1894.—Dixon & Jameson, Stud. Handb. 449. *pl. 56.* 1896.

Amblystegium curvipes Guembel, Bry. Eur. Ambly. 14. *pl. 7.* 1853.—Schimper, Syn. Musc. Eur. (1st ed.) 597. 1860. (2d ed.) 717. 1876.—Macoum & Kindberg, Cat. Can. Pl. 6:220. 1892.

Amblystegium ambiguum De Notaris, Epil. Bry. Ital. 144. 1869.

Amblystegium trichopodium var. *kochii* Lindberg, Acta Soc. Sci. Fenn. 10:275. 1872.—Braithwaite, Brit. Moss Fl. 3:30. *pl. 89.* 1896.

Amblystegium riparium var. *kochii* R. duBuysson, Ess. anal. gen. Ambly. 20. 1883.—Boulay, Musc. Fr. 77. 1884.

TYPE in Herb. Guembel, Berlin.

Gametophyte bisexual, of medium or large size, forming wide loose tufts, ordinarily pale, light green, to yellow: stems prostrate, 2 to 4^{cm} long, flattened or obscurely angled, 180 to 300 μ in diameter, cortex well differentiated, of two to three layers of cells, these 6 to 13 μ in diameter; central strand 30 to 35 μ , of ten to fifteen rows of cells; cells of ground tissue 13 to 35 μ in diameter; branches prostrate, ascending or sometimes erect, 1 to 3^{cm} long: leaves *long acuminate from a broadly-ovate or ovate base*, acumen slender, two-thirds the length of the body, sometimes equaling it or even longer; leaf attaining greatest width in the basal eighth, varying from serrulate in the middle leaf region to distinctly serrate throughout, costate, costa distinct, extending through two-thirds to three-fourths the length of the leaf, ceasing in the base of the acumen, one-sixth to one-fifth the leaf base at the line of insertion, 60 to 85 μ wide; many ranked, *commonly widely spreading from the base in all directions*, scarcely different in the dry condition, more or less crowded, 530 μ wide by 1400 μ long, ranging in width from 350 to 640 μ and in length from 1100 to 1500 μ ; leaf cells parenchymatous in basal eighth, prosenchymatous above, cells of alar region oblong to short oblong, occasionally quadrate, 15.7 μ wide by 25.8 μ long, varying in width from 11 to 17 μ and in length from 18 to 28 μ , the marginal two to three

rows narrower than those toward the costa, the latter 17 to 26 μ wide by 40 to 60 μ long, walls moderately thickened, above the cells pass rapidly through hexagonal or rhomboidal along the margin to almost linear hexagonal at the middle region, 10.4 μ wide by 54 μ long, varying in width from 9 to 11 μ and in length from 45 to 60 μ , rarely reaching 100 μ , in the apical region, cells essentially like those of the middle region, 10.7 μ wide by 56 μ long, varying in width from 9 to 11 μ and in length from 40 to 68 μ ; perichæcial leaves ovate lanceolate to oblong lanceolate, the outer spreading, the inner erect, all costate, serrate above.

Sporophyte medium to large: seta 2 to 4.5^{cm} long, 225 to 325 μ in diameter, cortex of three to four layers of incrassate cells, 8.5 to 17 μ in diameter: central strand large, 43 to 52 μ in diameter, of thirty to forty-five rows of cells; cells of ground tissue 9 to 33 μ in diameter: capsule oval to short cylindrical, asymmetric, moderately incurved from an erect base to horizontal or cernuous, pale throughout or darker on the convex side, constricted under the mouth when dry; collum small, one-sixth to one fifth the sporangium; cells of exothecium mostly parenchymatous throughout, occasionally prosenchymatous on the convex side, cells on the concave side 38.5 μ wide by 51.5 μ long, ranging from 26 to 64.5 μ wide and from 35 to 85 μ long, those of the convex side 33 μ wide by 105 μ long, varying in width from 18 to 47 μ and in length from 55 to 180 μ ; cell walls 2 to 3 μ thick, three to six rows of cells under the peristome smaller, hexagonal, isodiametric or occasionally transversely elongated, 10.7 to 40 μ long by 17 to 34 μ wide; stomata thirty-five to forty-five to the capsule, 42 μ wide by 57 μ long, scattered; teeth of peristome linear lanceolate, yellowish brown at base, margined, margin narrow below, abruptly wider at the middle, passing into the hyaline tip, upper half of teeth serrate, transversely striate on the back in the basal half, coarsely papillose above; endostome equaling the teeth, yellow, densely and coarsely papillose throughout, membrane not equaling the segments; the latter narrowly lanceolate, strongly carinate, open along the keel between the articulations, cilia two, occasionally

one or three, nodose to imperfectly appendiculate, usually shorter than the segments, occasionally equaling them; operculum as wide as the capsule, blunt pointed from a convex base; spores finely papillose, 16μ to 23μ in diameter: calyptra equaling the capsule or nearly so, split half its length.

HAB.: In moist shady places on earth. Type locality Germany.

Europe, Asia, North America: District of Columbia, Minnesota(?), Kansas. Not common.

Closely related to *A. riparium*, the smaller forms of which it resembles. It may generally be known from these by the long slender acumen and serrate margin of its leaves. It may be confused with large forms of *A. varium*. The leaves of the latter are commonly shorter pointed and have the leaf cells smaller throughout and especially shorter at the base.

AMBLYSTEGIUM VACILLANS (Sulliv.). *Plate XII. fig. 4.*

SYNON.: *Amblystegium vacillans* Sullivant, Mss. 1870. Icon. Musc. Suppl. 96. pl. 72. 1874. Macoun & Kindberg, Cat. Can. Pl. 6: 222. 1892.

Hypnum vacillans Lesquereux & James, Man. Moss. N. Amer. 377. 1884.

Gametophyte bisexual, medium to large, loosely cespitose, pale yellowish green: stems prostrate or floating, sparingly branched, 2 to 6^{cm} long, 175 to 385μ in diameter; central strand poorly differentiated, 20 to 30μ in diameter, composed of six to ten rows of large cells, 6.5 to 12μ in diameter; cortex of three to five layers of cells 6 to 17μ , those of the ground tissue abruptly larger, 17 to 35μ ; branches short, 1 to 2^{cm} long: leaves lanceolate to oblong lanceolate, attaining greatest width in basal third, acuminate or acute, *tip broad and blunt*, slender, *entire*, costate, costa distinct, extending three-fourths to four-fifths the length of the leaf, about one-seventh the leaf base at line of insertion, 35 to 47μ wide; many ranked, complanate or equally spreading on the branches, open erect, in small plants 400μ wide by 1340μ long, ranging from 330 to 450μ wide and from 1050 to 1550μ long, in larger plants reaching 685μ wide by 2150μ long; leaf cells parenchymatous at base, leaf ordinarily separating from the stem leaving at the basal angle a small group of quadrate or

short oblong cells, 13μ wide by 22μ long, varying in width from 10 to 15μ and in length from 18 to 25μ , sometimes below these is a row of slightly inflated and elongated cells across the base 20 to 26μ wide by 40 to 50μ long, the cells in the one or two marginal rows at the base frequently much elongated, reaching 100μ , in all parts of the leaf above the basal eighth cells prosenchymatous, in the middle region linear, 8.3μ wide by 49μ long, ranging in width from 6.5 to 9μ , and in length from 40 to 56μ , in the apical region shorter, slightly wider and more or less irregular, oval, hexagonal or rhomboidal, 8.6μ wide by 23.5μ long; outer perichætal leaves triangular, reflexed from the middle, the inner lanceolate or oblong, erect, all acuminate, costate, costa vanishing in the acumen, entire.

Sporophyte medium, 1.5 to 25cm long: seta brown below, paler above, slender; capsule light brown when old, 1.5 to 2mm long, cylindrical, oval or obovate, asymmetric or rarely almost symmetric, from erect to incurved, not constricted under the mouth when dry; collum one-sixth to one fourth the length of the sporangium; cells of the exothecium irregular, mostly parenchymatous throughout, somewhat prosenchymatous on the convex side, cells on the concave side 32μ wide by 50μ long, varying in width from 15 to 47μ and in length from 21.5 to 77μ , on the convex side 28μ wide by 62μ long ranging from 13 to 38.5μ wide and from 25 to 86μ long; three to six rows of cells under the mouth transversely elongated, hexagonal, 21.5 to 43μ wide by 8.6 to 25.8μ long; cells walls 3 to 4μ thick; stomata twenty to thirty to the capsule, scattered, 32μ wide by 38μ long; peristome teeth narrowly lanceolate, brown below, pale above, narrowly margined, transversely striate on the back below the middle, papillose above, serrulate above; endostome pale, papillose throughout, faintly so on the membrane, this only one half the length of the segments, segments linear lanceolate, carinate, open along the keel between the articulations, cilia one or two, short, one half the length of the segments, nodulose; operculum conic; annulus narrow, of one row of cells: spores finely punctulate, 13 to 18μ in diameter: calyptra not seen.

HAB.: That of *A. riparium*. Type locality White Mountains, New Hampshire.

North America: New Hampshire, New Jersey, Ontario. Rare.

Closely related to *A. riparium*. It may be known by the irregular and usually very short cells in apical region of the leaf and the wide blunt tips of the branch leaves.

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EXPLANATION OF PLATES XI-XIII.

The leaf outlines were magnified 85 diameters in the original drawing; the cells from the three leaf regions 580 diameters; *fig. 3l* (*pl. XII*), 340 diameters; *fig. 3f* and *3f'*, and *3g* of the same plate 160 diameters; and *3h* 10 diameters. All originals reduced one half.

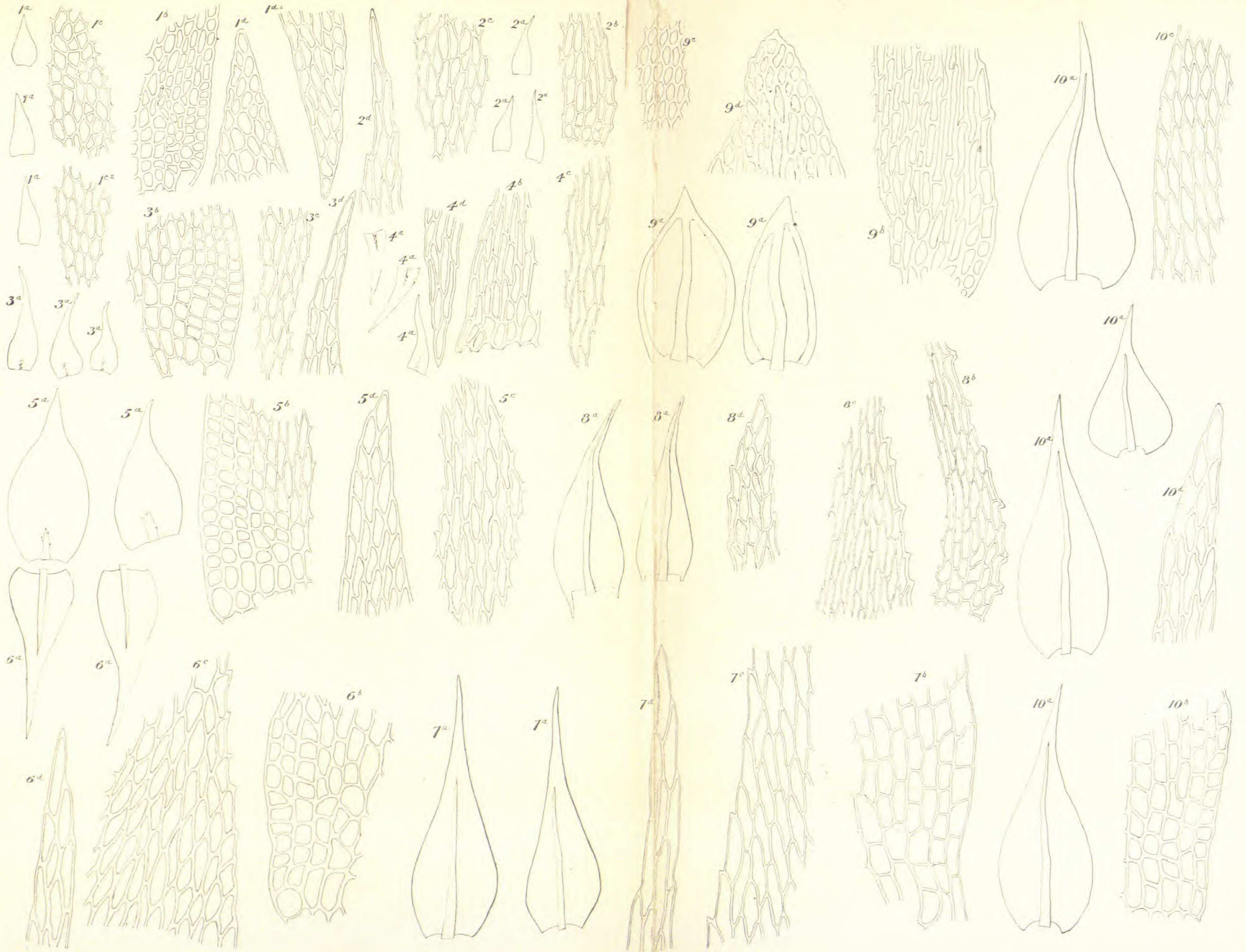
PLATE XI.

FIG. 1. *A. confervoides*: *a*, leaf; *b*, cells from the alar region; *c*, cells from the middle region in American plant; *c'*, cells from the middle region in European plant; *d*, cells from the apical region in American plant; *d'*, cells from the apical region in European.

FIG. 2. *A. sprucei*: *a*, leaf; *b*, cells from the alar region; *c*, cells from the middle region; *d*, cells from the apical region.

FIG. 3. *A. subtile*: *a*, leaf; *b*, cells from the alar region; *c*, cells from the middle region; *d*, cells from the apical region.

FIG. 4. *A. minutissimum*: *a*, leaf; *b*, cells from the alar region; *c*, cells from the middle region; *d*, cells from the apical region.



CHENEY on AMBLYSTEGIUM.